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ABSTRACT

This document was developed to provide primary level school teachers in New York City with specific materials and suggestions for organizing effective learning experiences in the science area. The program is designed to emphasize both science knowledge and science processes. An introductory section presents ideas related to the overall philosophy and organization of science instruction at the primary level. The major portion of the document contains teaching activities which deal with such topics as: (1) spaces; (2) what's alive; (3) discovery through our senses; (4) using a magnifying glass; (5) seeds and fruits; (6) heat and foods; (7) light; (8) magnets; (9) water; (10) balances; (11) bubbles; (12) weather; (13) animals and plants; (14) motion; (15) sunlight and shadows; (16) soil; and (17) air. Also included is a list of films and filmstrips related to the topics and an annotated bibliography of children's books and professional books on the teaching of science in the elementary school. (TW)

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SCIENCE

GRADES K–2

NEW YORK CITY PUBLIC SCHOOLS
OFFICE OF CURRICULUM DEVELOPMENT AND SUPPORT
DIVISION OF CURRICULUM AND INSTRUCTION

SE 048 786

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FOREWORD

This handbook for science in the Kindergarten, Grade 1, and Grade 2 has grown out of a program of curriculum development, evaluation, and revision first initiated in New York City schools in 1958.

The present material draws heavily on the experience of the schools in trying out material presented in a series of seven handbooks published under the general title *Science: Grades K-6* (Curriculum Bulletin, 1958-59 Series, 2a-2g).

The present handbook, *Science: K-2*, presents a teaching program for each of the grades K, 1, and 2. The kindergarten material is completely new. There is also new material on pre-kindergarten science which is included in the publication, *Pre-Kindergarten Curriculum* (Curriculum Bulletin, 1965-66 Series Number 11).

Science: K-2 endeavors to provide the teacher with specific materials and suggestions for organizing effective learning experiences in the science area. The program which is presented emphasizes both science knowledge and science processes. Among the new features which merit special attention are the evaluative items which follow each of the major topics.

In behalf of the school system I wish to express my appreciation to the Bureau of Curriculum Research, the Office of Science Education, and the hundreds of teachers and supervisors who have made this publication possible by their work in the classroom, by their designing of materials, and by their care in the preparation of this handbook.

ACKNOWLEDGEMENTS

This handbook was developed under the direction of Joseph O. Loretan, Deputy Superintendent of Curriculum, as a joint venture of the Division of Elementary Schools, Truda T. Weil, Acting Associate Superintendent; the Division of Curriculum Development, Jacob H. Shack, Acting Associate Superintendent; the Bureau of Curriculum Research, William H. Bristow, Assistant Superintendent; and the Office of Science Education, Samuel Schenberg, Director.

The preparation of this handbook was a cooperative enterprise which enlisted the efforts of hundreds of teachers and supervisors in the Elementary Science Revision Project. The general coordinating group for the Revision Project consisted of William H. Bristow, Samuel Schenberg, Harry Milgrom, and Julius Schwartz.

Harry Milgrom, Assistant Director, Office of Science Education, supervised the Revision Committee and reviewed and contributed to the materials developed for this handbook.

Julius Schwartz, Consultant in Science of the Bureau of Curriculum Research, was the principal researcher and writer for *Science: Grades K-2*, and chairman of the Revision Committee.

Muriel Green, Science Consultant, Bureau of Curriculum Research, was the assistant chairman of the Revision Committee and researcher and writer of science curriculum materials for this handbook.

The Bureau of Early Childhood, Rebecca A. Winton, Director, and Alice Harwood, Assistant Director, participated in the research and development of the kindergarten materials in this handbook.

The following district science coordinators, members of the Revision Committee, participated in the writing, testing and evaluation of the handbook materials: George Barr, Arthur DeSantis, Esther Marcus, Norman Matlin, Anna M. Rosenblum, Joan Rosner, Abraham L. Sperber, Helen Strachan, Thomas G. Vinci, Ada Werner, and Bernard Wertheim. Herbert Karp, Assistant Principal, P.S. 197, Queens, also served on the Committee.

A panel of principals served as advisors to the Revision Project. The panel included Paul J. Fitzgerald, 164 K; Thea S. Klein, 59M;

Irving Kreitzberg, 41 M; Sidney Levy, 92 X; Maude E. McGrath, 29 R; Hermine J. Nelson, 99 K; Pearl Newman, 16 K; Emil Soskind, 188K; Dirck Stamler, 75M; and Mary E. Vogt, 134 Q.

The team responsible for planning, writing, researching, and rewriting the kindergarten topics consisted of Julius Schwartz, Muriel Green and Alice Harwood.

Alice Harwood provided leads into the overall kindergarten program which served as a guide for developing the science potential in that program.

The kindergarten materials were tested in an experimental project in eighteen pilot schools through the cooperation of the kindergarten teachers and their principals. Their names can be found in the section titled *Development of the Science Program for the Elementary Schools of N. Y. C.*

Acknowledgement is due also to the many teachers, supervisors, science coordinators, curriculum assistants, and specialists from institutions outside the Board of Education who assisted in the preparation of the seven handbooks in the original series, *Science: K-6,* which has served as the basis for the current revision program.

Victor Spevack, Bureau of Audio-Visual Instruction, assisted the Revision Committee in preparing the list of films and filmstrips. Lucia Engels, Bureau of Libraries, assisted in the preparation of the bibliography. Thanks are extended to Edward G. Bernard, Director of the Bureau of Audio-Visual Instruction, and to Helen R. Sattley, Director of the Bureau of Libraries, for their cooperation. Richard R. Kinney, Supervisor of School Gardens, prepared the draft of *The School Garden in the Science Program.*

Anna Maltz, in charge of stenographic and typing services at the Bureau of Curriculum Research, gave expert assistance in the setup and preparation of the typed material at various stages of its production.

Jan Margo made the illustrations and designed the layout for this handbook. Maurice Basseches, Editor, had overall responsibility for design and production.

DEVELOPMENT OF THE SCIENCE PROGRAM FOR THE ELEMENTARY SCHOOLS OF N.Y.C.

The science program for the elementary schools stems from a series of projects that have been under way for almost two decades to give the study of science full status in the elementary curriculum in New York City.

One project, originating in two districts, resulted in the preparation of *Science in Everyday Living* (Curriculum Bulletin No. 6, 1947-48 Series). This publication, reporting early childhood activities and experiences in the classroom, was distributed to all elementary schools in New York City.

Material developed in other districts for the intermediate grades was published as *Source Materials in Elementary Science* (Curriculum Bulletin No. 3, 1949-1950 Series). This publication, outlining science materials, experiences, and units, was also made available to all schools.

To meet the need for broader consideration of the overall K-12 science program, exploratory studies and conferences were conducted in 1950 culminating in the appointment and work of a science advisory panel which established a set of goals and principles later accepted as a working program by the Curriculum Council.

Another step was taken in 1950 when the Curriculum Council of the Board of Education designated a Science Advisory Committee to coordinate the development of a 12-year science program for the New York City Schools. This committee consisted of:* William H. Bristow, Director, Bureau of Curriculum Research, Chairman; Alfred D. Beck, Science Supervisor, Junior High Schools; Francis X. Carlin, Science Supervisor, Vocational High Schools; Harry Milgrom, Science Supervisor, Elementary Schools; Samuel Schenberg, Science Supervisor, High Schools; Jacob H. Shack, Assistant Superintendent, Division of Curriculum Development, Secretary.

Concurrently, committees of teachers and supervisors were set up to prepare courses of study in science for the elementary, junior high school and senior high school levels.

The work of the elementary school committee was directed first by the late Isaac Bildersee, Assistant Superintendent, and then by Herman Schneider, former Science Supervisor, Elementary Schools.

During 1953, a committee under the chairmanship of Harry Milgrom and including Ruth Berken, Allen Burnham, Frances Harmon and Martha Shapp prepared a *Course of Study in Science for the Elementary*

*The positions indicated are those which were held in 1950.

Schools, Grades K-6, which was adopted by the Board of Superintendents and the Board of Education in July, 1954. This gave the elementary schools the first approved framework on which to build a science program, and completed the process of organizing a science sequence from the kindergarten to the twelfth grade.

A program of curriculum development and implementation was approved by the Board of Superintendents at its meeting on January 4, 1955 and became known as the Elementary Science Project. This project was a joint undertaking of the Bureau of Curriculum Research and the Office of Elementary Science.

Thirty-one pilot schools in seventeen districts participated in the development of materials. To facilitate organization of production a committee was designated to develop materials in each of the seven areas of the program: Magnetism and Electricity, The Earth in Space, Living Things, Sound and Light in Communication, Weather, Motion and Force in Transportation, and Earth and Its Resources. Each committee consisted of teachers and supervisors from pilot schools, district science chairmen, curriculum assistants, science coordinators, and in some cases, representatives of cooperating institutions in New York City.

The work of the seven committees was under the direction of Harry Milgrom, Supervisor of Science for the Elementary School Division, and coordinated by Julius Schwartz, Consultant-in-Science of the Bureau of Curriculum Research.

The reports of the committees were prepared for publication by an editorial committee consisting of Allen Burnham and George Barr, Office of Elementary Science, and Julius Schwartz, Chairman. Jan Margo, a teacher in the All-Day Neighborhood School program at P.S. 108 M., served as a consultant and illustrator for the handbooks.

Between the years 1958 and 1962 the seven handbooks, *Science: Grades K-6,* (Curriculum Bulletin 1958-59 Series, Numbers a-g) each dealing with a separate area of science from Kindergarten to Grade 6, were distributed to all of the elementary school teachers of New York City. During this period, an intensive program of teacher training was instituted to implement the use of the handbooks in the schools. Under the leadership of Harry Milgrom, the staff of science coordinators assigned to the twenty-five district superintendents conducted workshops, demonstration lessons, in-service courses, and faculty and grade conferences to familiarize the teaching staff with the new program.

In-school television programs for children, based on the handbooks, were cooperatively developed by WNYE, the Bureau of Curriculum Research, and the Office of Science Education. These programs served both for direct pupil instruction and for teacher training.

After-school television programs for the training of elementary school teachers were initiated by Samuel Schenberg, Director of Science, and supervised by Harry Milgrom, Assistant Director, with the active cooperation of WNYE, the Bureau of Curriculum Research and the Division of Elementary Schools. Teachers' guides for these purposes were prepared and distributed. These television courses for teachers were held at the end of the school day and were received in school centers throughout the city. Each telecast was followed by an intensive workshop, using the materials presented on the program. In a later period the same course was presented to teachers who wished to view it at home, and a special guide was prepared for that purpose by Muriel Green, Science Consultant.

The emerging elementary science program was accompanied by an expansion of science fairs, clubs, assembly programs, and trips. More and more, science became part of the daily experience of all elementary school children.

In 1963, the Bureau of Curriculum Research and the Office of Science Education launched the present revision program. One reason for the revision is to bring together science content formerly presented in seven handbooks, so that a teacher may find all of the instructional materials for her grade in a single publication. At the same time, the revision reflects recent advances in the field of science, and in the methods of teaching science. While retaining the basic scope and sequence of the original series, the experiences are enriched, and the number and variety of activities are increased. More suggestions are given to the teachers to stimulate the teaching of science as inquiry, through approaches which place children in the role of innovators, explorers, and discoverers. The teacher is given more assistance in planning, in using equipment, and in meeting the needs of children with varying abilities and interests. New introductory materials are incorporated to highlight modern developments, trends, and emphases in modern education. Integral to the revision are a series of items to assist the teacher and the children in evaluating the effectiveness of the teaching and the learning.

A Science Revision Committee, consisting of district science coordinators, worked on this new handbook during 1963-1965. Work continued through the summer of 1964 to expedite the production of materials.

In this handbook, as contrasted with the original, the K-2 content is clearly divided into Kindergarten, Grade 1, and Grade 2. The decision to have such a division, and consequently to initiate a separate kindergarten program, was based on the following considerations.

Numerous requests for a breakdown of K-2 materials into K, 1, and 2 came from the teachers, supervisors, and science coordinators.

The kindergarten has a tremendous potential for science which had not been tapped sufficiently in the past.

Participation in carefully designed activities at the kindergarten level provides a rich reservoir of experiences upon which to build a sound understanding of the basic scientific concepts which will be considered in the elementary grades.

The introduction of science activities in the kindergarten, because of their concrete nature, will help children adjust to their immediate environment more readily.

The kindergarten material presented in this handbook constitutes a completely new program. In order to develop these materials an experimental project was initiated in the fall of 1963, under the direction of the Bureau of Curriculum Research, the Bureau of Early Childhood, and the Office of Science Education. A Kindergarten Team consisting of Julius Schwartz, Muriel Green, and Alice Harwood was assigned to design model materials for the project. The team met regularly with Samuel Schenberg and Harry Milgrom for suggestions and consultation. The first step in developing the materials consisted in reviewing the over-all kindergarten program and in identifying the science potential in the daily experiences and routines, the changing seasons, and the centers of activity in the kindergarten. This was followed by visits to kindergartens in P.S. 191 Manhattan, P.S. 28 Bronx, and the Bank Street School. On the basis of these studies and visits, eight model topics were written. In the summer of 1964 some members of the Revision Committee participated in a curriculum production workshop to rewrite and extend the materials developed by the kindergarten team into eighteen experimental topics. In the fall of 1964 an orientation meeting was called of eighteen kindergarten teachers who were to teach and evaluate the experimental topics during the months of November and December 1964, and January, 1965. Each teacher was assigned three of the eighteen topics to try out during these months. Thus each topic was taught by three different teachers, whose classes were representative of the different kinds of neighborhoods in the city. At the completion of each unit an evaluation form was filled out by the teacher to assist in the final revision.

During the tryout period, the Kindergarten Team visited each of the eighteen pilot teachers and their classes to observe the topics being taught, to participate in the teaching of the topics, and to confer with the teacher and her principal. As a result of these visits, and on the basis of the evaluation reports of the pilot teachers, the topics were rewritten. The

fifteen topics which finally emerged from this process are now a part of this handbook.

The following kindergarten teachers and their principals served in the pilot schools for the kindergarten science project: P.S. 51, Manhattan: Victoria Giles, teacher and Grace Canary, principal; P.S. 161 Manhattan; Janatte Piper, teacher and Bernard Friedman, principal; P.S. 191, Manhattan: Rita Dawson, teacher and Stanley Becker, principal; P.S. 192, Manhattan: Leonore Kast, teacher and Seymour Gang, principal, P.S. 15, Bronx: Nora Rey, teacher and Adeline Miseo, principal; P.S. 24, Bronx: Lucy Brinson, teacher and Sidney N. Levy, principal; P.S. 28, Bronx: Norma Goodfriend, teacher and Irene R. Bonardi, principal; P.S. 75, Bronx: Helen Callahan, teacher and Joseph Shapiro, principal; P.S. 124, Bronx: Mary Phillips, teacher and J. Roland Gallo, principal; P.S. 37, Brooklyn: Angela Leone, teacher and Norma W. Klass, principal; P.S. 65, Brooklyn: Marilyn Greenberg, teacher and Helen A. Sullivan, principal; P.S. 180, Brooklyn: Helen Harris, teacher and Morris Rubens, principal; P.S. 196, Brooklyn: Jeanette Mannes and Naomi Anderson, teachers and Albert Goldstein, principal; P.S. 58 Annex, Queens: Alice Giebel, teacher and Alan R. Sherman, principal; P.S. 90, Queens: Leona Farrant, teacher and Alex M. Kirsch, principal; P.S. 111, Queens: Elinor Gallant, teacher, and Seymour J. Sherman, principal; P.S. 116, Queens: Carolyn Colon, teacher and Catherine M. Dooley, principal; P.S. 144, Queens: Ruth Davidson, teacher and Irving Gerber, acting principal.

Vivienne Hochman, teacher assigned to the Bank Street Workshop in the N. Y. C. schools, reviewed some of the early materials, and provided valuable insights and approaches to science in the kindergarten.

Because of the urgency of the fast developing *Operation Headstart,* the Kindergarten Team was assigned to write a science program for the pre-kindergarten curriculum. This science material appears in the *Pre-Kindergarten Curriculum Guide,* which includes all the curriculum areas, and should now be considered a part of a Pre-Kindergarten—Grade 12 science program of New York City.

Present plans call for the publication of the revised materials of *Science 3-4* in 1966.

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Introduction

MEETING THE NEEDS OF ALL CHILDREN

Science has something to offer every child, not just the miniature astronaut and the infant Einstein. Science meets the needs of all children since it offers them opportunities to explore, to manipulate, and to discover as they try to find the what, how, and why of the world around them.

The Science Handbooks are designed to provide a variety of experiences in the form of trips, experiments, constructions, and projects which will appeal to children of varying backgrounds, interests, and capacities. The kindergarten topic, *Uphill and Downhill*, for example, is initiated by providing all children with the common experience of climbing up and down a hill. Later, in the classroom, children build hills of their own with available materials, and test their hills with rolling objects. Many will discover that the steeper the hill the farther a ball will roll from it. All of the children will understand the safety implications in skating, sledding, and bicycling down a hill. Some may begin to relate the motion of objects on a hill to problems of gravity and space travel. Children's vivid and satisfying experiences with concrete things stimulate vocabulary building as they describe the objects (ball, car) and the actions (rolls down) which they observe.

Books play an important role in meeting the needs of individual children. Their usefulness is enhanced if the teacher makes available a variety of books related to the science topic being studied. See *Science and the Reading Program*, pages 12-14.

Many Kinds of Lessons

There are many roads to science learning and there are many settings for science teaching. The developmental class lesson, led by the teacher, is only one of the shapes that a lesson may take. On different occasions, children may work in small groups or by themselves. Since children learn at different rates and in different ways, there must be many opportunities for individual work. Children need time to think, time to work things out for themselves, without pressure from their classmates or teacher. Not all children will be necessarily working in science at the same time.

Science lessons come in many "sizes" and "shapes". Characteristically, children may be experimenting, constructing, discussing, reading, observing, making drawings, making measurements, making exhibits, taking care of plants and animals. Science lessons may take the form of a planned trip in or around the school building, to the school garden, in the neighborhood, or to a nearby park. A science lesson may be the spontaneous reporting by children of what the windstorm did the previous night. A science experience may last two minutes, five minutes, an hour or more. It may be part of an interrelated series of experiences and activities, or it may stand uniquely by itself.

Using This Handbook to Meet the Needs of All Children

In the *Approaches and Concepts for the Child*, for each topic you will find the significant concepts which all children should learn. Following these are suggested problems. For example: in Grade 2, Topic B, *The Strength of Magnets*, is developed through such problems as the following.

1. How strong are the different parts of a magnet?
2. How can you measure the strength of a magnet?
3. Can magnets attract through various substances?
4. From how far will a magnet attract a clip?
5. How long a chain of clips can you make with a magnet?

For each topic the teacher *will use those problems that best serve the needs and interest of her group*. The problems should also be selected so as to develop adequately the basic concepts stated in the introduction to the topic. The teacher should feel free to further extend the investigation of the topic along lines suggested by the children.

Following the presentation of each problem in the Handbook there is included a list of understandings which the children may be expected to gain. It is important that the understandings be formulated by the children on the basis of their experiences and *be expressed in their own words*. It is not intended that all children or all classes will arrive at all of these understandings, or be limited solely to these.

In summary: when we approach science as an exploration, we invite each child to make his own contribution to this unique enterprise, and to share in the learnings of all.

SCIENCE AS PROCESS AND AS KNOWLEDGE

"Science means various things to different people. Many accept it as an organized body of content to be studied from a science textbook. Some think of it as a new kind of magic. Others consider it to be an absolute authority.

An increasing number believe it is something to be feared. Comparatively few recognize science for what it is — an enterprise created, designed, and managed by human beings. . . . We must make every effort to help our young people understand science in this light. To do this we must keep in mind the two basic components of science.

"One component has to do with science as a way of investigating the world of nature. . . . But science is more than a way of finding out. It is what the scientist finds out, not only the method. It is the tested knowledge of our environment that has come from using the methods. . . . At the pinnacle of this knowledge, however, are the grand ideas that have been forged in the creative, informed minds of scientists. . . . Both process and product are inextricably involved in the scientific enterprise. Both represent human activity. . . .

"As teachers we properly refer to the process part of science teaching as problem solving. In order to teach science as problem solving, we must get children involved in the process. They must be encouraged to ask questions; but more important we must help them develop the ability to ask thoughtful questions. Children must be encouraged also to speculate about answers to their questions. . . .

"We cannot give children the science ideas which they are supposed to understand. Each child "catches," or comes to understand, an idea on his own. Our job is to set the stage for this to happen and guide the process once it is under way."*

The material in this handbook is designed to combine the two components of science, *process* and *knowledge*. For example, the observation and measurement by children of the changes in length and direction of a given shadow at different times (process) leads them to the generalization that the sun changes its position in the sky during the day (knowledge).

The understandings listed at the end of each problem in this handbook, and the broader concepts found in the introduction to each topic, represent *knowledge* that should flow from the children's investigations. Interwoven in the development of each problem and implicit in the question which triggers each problem is the *process*.

Following are some of the processes in science investigations. The listing given here is not intended to suggest the order in which the investigation is to proceed. Nor is it essential that all of these be included in any one investigation. *And we should keep in mind that while children are discovering, they*

*From "What is Science" by J. Darrell Barnard. *Elementary School Science Bulletin* No. 63. National Science Teachers Association, Washington, D.C. September, 1961.

should be finding out something which, for one reason or another, they want and need to know.

1. Asking Questions. This handbook is designed to encourage the asking of questions. The posing of a question is an invitation to children to engage in a scientific enterprise. Of course the most significant questions are those which children ask. See *The Role of Questions* on page 6, for further discussion of this topic.

2. Experimenting. An experiment is a way of finding out; it is not an end in itself. In an experiment the materials are carefully selected and the conditions are carefully arranged. This is different from an *experience* in which the materials and events are observed in the natural world. An experiment is a technique through which man tries to discover nature's secrets.

One aspect of the experiment is the *control.* When children are asked how they can be *sure* that a certain condition produces a given effect, they are led to see the need for a control. For example, if a child hypothesizes that hanging a wet cloth in sunlight will make it dry faster, he should also hang a similar wet cloth outdoors in the shade. The one in the shade serves as the control. It makes possible an accurate comparison leading to a reasonable conclusion.

Children should be encouraged to devise their own experiments. It will be helpful for the teacher to ask frequently, "How can we find out . . . ?" Indeed, the children's involvement in planning an experiment is just as important as the doing of the experiment. They should plan (if possible) to test a single factor at a time. For example, if they wish to find out whether green plants need light, they place some plants in the light and some in the dark, and water them equally. If they do not water both sets of plants, they will not know whether the difference between the plants is the result of lack of water, or lack of light. A number of plants in the light and in the dark are used to answer the criticism that the plant in the dark may have been "a sick plant to begin with".

3. Predicting. Children should be encouraged to predict results, to propose explanations and then to test them. Predicting results will help children focus their thinking on a problem. Checking results will help them evaluate their thinking. The process of predicting also adds excitement and a sense of "playing a game" to the learning of science. In the kindergarten, children are asked to predict what will happen when a piece of chalk is dropped to the floor. After observing the result, they are asked to predict what will happen if the chalk is dropped from a greater height. In Grade 2, when children are observing and measuring the growth of a bean plant, they are asked to predict what the plant's height will be 4 days after their last "reading". Of course they will check their guess later.

4. Observing. This involves making use of the senses to gather information. Children use their muscles and other parts of their bodies to make observations as they push, pull, put things together, and take things apart. The teacher encourages them to use all their senses when they investigate, and to report what their senses indicate. Sometimes they extend what they learn from their senses by using an instrument. A hand lens, for example, helps them see a tiny insect in greater detail.

5. Interpreting. This involves comparing sizes (longer, shorter, larger, smaller), comparing textures (smooth, rough), and weight (light, heavy) of common objects. It includes distinguishing and naming temperature differences as being warmer or colder; identifying sounds made by familiar objects or events; identifying odors of familiar substances. It involves noticing *changes* in color, size, odor, state (such as from solid to liquid), shape, and position.

6. Measuring. Observation may include measurement. Rough measurements come first, and then instruments are used to refine these measurements. A child puts his finger into a glass of water. He feels (observation) that the water is warm. He then places a thermometer in the water to see how warm it is (measurement). Sometimes children make their own measuring instruments: paper strips are cut to indicate the height of a growing plant over a period of time, and these strips are arranged to form a graph which represents the growth that took place.

There are stages in the development of measurement skills. A child grows a number of plants from seed. He first compares the height of two plants and sees that one is taller than the other. He then asks himself, "How much taller?" and measures to find the answer.

Instruction in the process of measurement is planned so that the child understands the concept of a unit of measurement. Thus in Grade 2, children use a steel paper clip as a unit of magnet strength. They can compare the strength of two magnets when they find that one will pick up 10 clips and the other 18.

7. Keeping Records. Records are kept in many ways: in written words, maps, photographs, tape recordings, numbers, drawings, graphs, and in collections of objects (for example, dry seeds from various plants displayed in transparent containers). When children gather data and look at it, they begin to understand that many examples make generalizations more valid. For example, when *every* child in a class examines pea pods and reports on the number of peas in his "own" pod, the class arrives at a more reliable conclusion about the number of peas generally found in a pod than from the reports of one or two children.

Gathering data, of course, is not enough. It has little value unless the data is examined and interpreted.

8. Classifying. This involves collecting and organizing things. It may mean separating things to find likenesses or differences. It involves comparing things and grouping them. Children should be guided to an awareness of the reasons for classifying things: to simplify, to get to underlying or basic similarities and differences. Children should be encouraged to classify things for their own reasons, and to use their own basis for classification. They may wish, for example, to organize their rock collection on the basis of size (small or large), or on the basis of surface (smooth or rough), or on the basis of color (light or dark). Each of the methods may have significance to the child. In later years they may wish to use more standard methods of rock classification.

9. Generalizing. At the end of each problem in the Handbook there are *some* of the understandings or generalizations that children may suggest. These are based on their observations, experiences, and experiments. Throughout the work in science children should be encouraged to generalize in their own words. This will make the process of forming generalizations one which involves careful, critical thinking.

THE ROLE OF QUESTIONS IN TEACHING SCIENCE

Good questions are the keys to good teaching in all curriculum areas. In science, questions have a special role since they are the starting point for children's investigations. In spirit, this is essentially the way in which scientists initiate research. Questions give purpose and direction to activity. Therefore the science program outlined in this handbook is developed through problems that are posed as questions.

Children ask questions naturally. An important goal in science teaching is to encourage and cultivate this questioning attitude. Children should feel that school is the place to ask questions, that their questions are important, and that questions often trigger exciting explorations. The teacher helps set the stage by arranging for situations which provoke questions. By the kinds of questions he asks, the teacher also serves as a model for the children as they develop and improve their skill in questioning.

Answers are found in a variety of ways. Occasionally the teacher, a book, or other children may provide answers. However, answers become more meaningful when children find them in the course of their *own* investigations.

Questions serve many purposes. Some useful question starters are:

"What would happen if . . .?"
"How can we find out . . .?"
"How could you be sure that . . .?"
"How can we (do) . . .?"

"How many ways can we (do) . . .?"
"Where could we find . . .?"
"What happened . . .?"

And let us not forget to ask children, "What questions do you have?" and to counter children's questions frequently by asking, "What do you think?"

Children should come to understand that there are many questions for which there are still no answers. We do not know exactly what the surface of the moon is like, nor whether life exists on Mars, although, before the next edition of this handbook appears, we may have the answers. As children go on with their science studies they will understand that *all* answers in science are man-made, hence subject to error and subject to change. There is no final and absolute authority in science. This does not, however, deny the importance of the principles and theories which scientists have constructed to explain phenomena. But those principles and theories which are most significant in science are those which lead to further discovery of new principles and theories.

The significance for the teacher of this approach to science "answers" is that children's ideas and proposals should be considered, and that the teacher need not become *the* authority or a spokesman for *the* authority. Rather, science in the classroom should be an adventure in which children and the teacher participate. Children should come to regard science as an endless quest rather than a finite body of information.

Following are some typical questions related to the work in *Science: K-2*, grouped to indicate their special character.

Questions which draw on children's home experiences

Where have you seen magnets used?
How do you take care of your pet?

Questions which lead to trips and surveys

Where can we find hills in our neighborhood?
Where does the water in our faucets come from?
How many different kinds of plants can we find in our neighborhood?
Have all the trees in our neighborhood lost their leaves?
What moves on wheels on our street?

Questions which lead to close observation

Are all the soap bubbles the same size?
How do different things mix with water?
What is in the soil?
What is sand made of?
How does the (musical) triangle feel to you when it is making a sound?

Questions which provoke experimentation

How can we make ice melt more quickly?
How can we make a wet towel dry more quickly?
Why is salt sprinkled on icy sidewalks?
What happens when seeds are planted at different depths?

Questions which help children group and classify

Do all the blocks look alike?
What things float and what things sink?
What will a magnet pick up?
What makes tracks in the snow?
How can we make a rock collection?
What kinds of seeds can we find in the supermarket?

Questions which lead to measurement and collecting of data

How far did the toy car roll?
Which magnet is stronger?
Which of the plants grows most rapidly?
How do shadows change during the day?
How can shadows help us tell time?
What kinds of materials let water go through easily?

Questions which challenge children to propose ways of finding out

How can we find out whether soap really helps water clean things?
How can you tell what's in this bag without looking?
How can you tell which toy is heavier?
How can you find out if there are any seeds in a food?
How can you tell which way the wind is blowing?
How can we go hunting for iron?
How can we find out whether or not there is air in soil?

Questions which ask children to predict

What will happen to this ball of clay if we drop it on the floor?
What will happen to this glassful of snow if we bring it indoors?
What will happen to this plant if we stop watering the soil?
What will happen to the puddle in the schoolyard?
What will happen to the toy car if we start it rolling higher on the hill?
What will happen to the water in the tray if we put it outside today?

Questions which challenge children to propose explanations

Why does a ball of modeling clay flatten when it hits the floor?
Why did the water level in the aquarium go down?
Why do some things sink and some things float?
Why does an open parachute fall more slowly than a closed parachute?

THE ROLE OF THE EXPERIMENT

The classic way through which man tries to discover nature's secrets is by experimenting. When children experiment, they are intrigued by the elements of surprise and discovery that are a part of such investigations. They begin to develop patterns of thinking and working which are characteristic of scientists.

In the context of science teaching, we differentiate *experience* from *experiment*. Experiences may include the child's observing goldfish in an aquarium, climbing a hill and running down, taking a trip to a park to find signs of spring. An experiment, on the other hand, is usually a cooperatively developed enterprise (teacher and children) with appropriate materials set up for the purpose of finding the answer to a particular problem.

The significance of the experiment is that it helps to find something out rather than to prove something. *Its character is more "Let's find out whether . . ." than "Let's prove that. . . ."* The teacher sets the stage by providing situations which stimulate children to raise problems. In a real experiment, there should be some doubt about the outcome in the investigator's mind. The experimenter may predict the outcome, but he is uncertain of it.

Although an experiment is conducted to solve a problem, every research scientist has had the experience of finding new problems during his experimentation. Pupils, too, in their experiments will open up many new lines of thinking; as they attack one problem, additional problems are disclosed. Where feasible, therefore, the program of experimentation may be extended to include some of these new problems.

Finally, it should be noted that experiments are appropriate for any grade in the elementary school. Kindergarten children may observe what happens to certain materials (clay, sand, water, a wooden block) when they are dropped to the floor (into a pan) from a constant height. First grade children may experiment to find out how ice may be melted more quickly.

Guidelines for Experimentation

1. The Setting

The setting is provided by situations which may develop from asking the "trigger" questions in the science handbook, from children's individual experiences, from class trips, from provocative materials, from previous experiments. All of these may result in problems or questions. For example, after some kindergarten children had used heat to melt margarine, the question was asked: "How can we make the melted margarine hard (firm) again?"

2. Getting Into Action

The children should be given the opportunity to design the experiment and to decide on and gather the appropriate materials. Depending on the availability of the materials, physical conditions, and safety considerations, the

experiment should be performed by pupils individually, by groups working together, or by one group in the class. It is important that children have opportunities to manipulate the materials and to work at their own pace. Before proceeding with the experiment, the children should understand how the experiment is related to the problem to be solved.

3. Making It Scientific

Wherever possible, use a *control*. This is simply a method of providing a basis for accurate comparison. When children experiment to find out how water changes foods, they should keep a sample of the unchanged food for comparison. Then they will have the opportunity to see, feel and taste both the wet and dry foods and draw conclusions.

Test only *one* variable at a time. For example, when children experiment to find out what a plant needs to live, they should deprive the plant of *either* sunlight or water, not both. In this way, they can arrive at a conclusion that has validity.

Take advantage of the fact that you have a number of children who may perform the same experiment. It may be found that variations in the results that children get are due to differences in the *techniques* used, variations in *observational skills*, differences in ability to *report* their observations, or differences in the *materials* being used (the use of a weak dry cell as compared to the use of a fresh dry cell).

Results of experiments should be recorded, reported, and summed up, to help the children gain the most understanding from the experiments. The greater the number of experiments and observations, the greater the possibility of arriving at a basic explanation or generalization.

4. When the Experiment Does Not "Work"

In a sense, every experiment "works", that is, what happens is a result of natural influences. For example, a pumpkin has been set up to study how ventilation helps a candle burn. If the candle goes out unexpectedly, this is not a failure; it is an opportunity. For here is a *real* problem—not one predetermined by the teacher. Asking the children how to solve this *real* problem leads to the highest degree of experimentation because children are actually cast in the role of scientists. They may suggest using a smaller candle; they may suggest making a bigger mouth (for air to enter); they may suggest using a bigger opening on top (for air to leave). All of these should be accepted and tested, as far as possible. Since during a school year, many of the investigations suggested in the handbook will lead to situations in which something appears not to "work", it is essential that the teacher capitalize on these opportunities for involving children in science learning.

MATERIALS IN THE ELEMENTARY SCIENCE PROGRAM

For the effective learning of science, children must have as many first-hand experiences as possible with real materials. To assist you in planning this, the handbook includes lists of materials that are necessary for each unit in Grades 1 and 2. In general, the lists are based on the assumption that children will work in groups of four, although there will be many occasions when the teacher may depart from this arrangement. The E-1 Science Supply List or the G-1 General Supply List contain the items which may be ordered at requisition time (usually in the fall).

Sources

In addition to the standard type of science materials provided by the school, such as magnets, magnifying glasses, and thermometers, the teacher has many other sources to draw from. These include materials that are found in the classroom such as the window pole, paper, paper clips, drinking straws, and empty milk cartons.

Much of the equipment normally found in the kindergarten, such as blocks, paints, and toys, are useful for science teaching, and the units for that grade draw mainly on these. Children can contribute science materials such as empty spools, leaves, pebbles, plastic containers, and shoe boxes. The local hardware, variety, and pet stores are sources of science materials. Neighborhoods with gardens, parks, beaches, ponds, and streams are excellent sources of science materials. Other sources of science materials are museums, the ASPCA, botanical gardens, zoos.

Since we continually emphasize conservation, children should be made aware of the need to discriminate when collecting in the out-of-doors. Thus removing a fallen leaf from beneath a tree does no harm; leaves ripped from branches may injure the tree. In general, plant species that are scarce, such as many of the wild flowers, and specimens that are on private property, are not to be collected. Small wild creatures, taken briefly to the classroom, should be housed and fed properly and eventually returned to the environment from which they had been removed. Children in early grades should be accompanied by an adult on any field trip.

Storage

It has been found that no one method of storage will be convenient for everyone. Shoeboxes or other containers may hold many materials for a particular unit such as the one on magnetism. This may be part of the permanent equipment for your room. Expensive equipment should be stored centrally and be available, on order, to the classroom teacher. Schools may

order cabinets containing tote trays for the storage of science equipment. Each school will select a method that best meets its needs.

Safety

The bulletin *For Greater Safety In Science Teaching* is in all schools and should be consulted.

The following rules will promote safety in the teaching of science.

1. Materials must be safe for children to use. For example, plastic containers should be used when possible, instead of glass containers.
2. Pupils are to be under the direct supervision of a teacher at all times.
3. Pretest devices or equipment brought in by a child before using them with the children.
4. Discuss safety cautions in handling materials for which there might be a special hazard, even if the teacher is demonstrating them. Discuss the science principles involved in safety. For example, water and sand should be available whenever we are working with fire.
5. Wherever possible, the safety application of science principles should be taught. In the kindergarten topic *Uphill and Downhill*, for example, a basis is developed for understanding the potential dangers in skating, sledding, and bicycling down steep hills.
6. House current (110 volts) is NOT to be used. Only dry cells (1½ volts) are to be used for experiments with electricity.
7. Children are NOT to carry laboratory equipment or apparatus through the halls when classes are moving about.
8. Children are NOT to taste chemicals or other materials. The only exceptions are foods purchased and handled under sanitary conditions.

SCIENCE AND THE READING PROGRAM

Children are fascinated by explorations in science, and this interest may be utilized in many ways to improve reading ability. The teacher can guide children in the use of newspapers, magazines, and books to find information, to satisfy curiosity, and to enjoy the sheer excitement of adventuring in science. In the early school years, youngsters become familiar with the elements of their environment which they can see, hear, feel, smell, taste, and touch. They add to their speaking and reading vocabularies the names of these elements and the words which describe impressions made by them: hot, cold; wet, dry; loud, soft; high, low; rough, smooth. From year to year, as new experiences introduce new science words, their speaking, reading, and writing abilities grow rapidly. For example, when planning a garden, children consult planting instructions to find out how to sow and care for their plants. They become familiar with the names of many common seeds, vegetables, flowers, and gardening tools. Educationally disadvantaged children, and those to whom

English is a second language, increase their English vocabulary as they learn words describing concrete objects and their use in science experiences.

Making Experience Charts, Oral and Written Reports, Graphs

Pupils are encouraged to describe in their own words what they want to investigate through their experiments, what they propose to do and to use, what they observe, and what they learn. The teacher may print an experience chart as the children dictate the story of each experiment. Once a child grasps the significance of such a statement, it will not take long before he can read the words of which the statement is composed. Gradually, he will gain the ability to write and read his own reports, thus further strengthening both science and reading skills.

Step by step, as children pursue their simple investigations, they are taught to prepare, read, and interpret charts, tables, and graphs which show the results of such measurements as length (of shadows), weight, time, temperature, speed (of wind), force, and direction.

Preparing Exhibits

In the preparation of hall and classroom displays, children practice the skills required in writing and reading titles, captions, labels, and descriptive text. Much of this work may require that pupils read and follow specific directions. Through all of these science activities, reading is needed and used.

Implementing Reading in Science

Children should be given an opportunity to select reading material. The teacher should make available a variety of suitable books and other references in anticipation of a topic that may be studied, or as a source of information after a question has risen. In this way, children begin to develop the habit of using many sources; they begin to appreciate the role of references in research. Printed matter in elementary science mostly falls into the following groups: textbooks, trade books, reference books, magazines and free materials.

Since New York City has its own well-defined curriculum in science, no single textbook provides the readings essential in our program. Texts are used as references, for supplementary reading, for useful illustrations or techniques. For this purpose children should have available the texts of different publishers and of different grade levels.

Trade books, with their great diversity of subject matter, reading levels, styles, and formats, are excellent aids to the teacher in meeting the needs of individual children. On pages 257-65, grouped according to science areas, is an annotated bibliography for K-2 children.

Reference books such as encyclopedias should be available, if possible, in the classroom and in the school library. Children need help, of course, in using these references properly.

Many manufacturers print material that may contribute to science learning in elementary schools. Their public relations departments are cooperative in sending supplementary material to the schools. The usefulness of each publication must be carefully assayed before making it available to the children.

AUDIO-VISUAL MATERIALS IN THE SCIENCE PROGRAM

A large variety of audio-visual materials is available in our schools; this permits the teacher to utilize a multi-sensory approach in the development of science concepts. These materials motivate learning and make it more pleasurable. Thus stimulated, the pupils become more curious and begin to investigate, read, explore, and experiment.

Some aids such as the chalkboard, the felt board, and the bulletin board appeal to sight. The chalkboard, particularly, is available to every teacher and has great potentialities. To illuminate an idea, a large clear sketch, in colored chalk if appropriate, is a fine teaching aid. The value of the chalkboard is enhanced if the teacher develops the drawing with the help of the children. The drawing grows as ideas grow, as children contribute to its lines and labels. The chalkboard makes it possible for all children in a group to center their attention on the same drawing while they discuss a problem. The pupils should be encouraged to use the chalkboard to explain and clarify their own ideas.

Motion pictures, filmstrips, and transparencies are used in various kinds of projectors found in the schools. Magazines and newspapers are good sources for pictures that may be hung in the classroom and viewed in greater detail by using the opaque projector. Charts and models that children make are often more meaningful than commercial ones.

Other aids appeal to hearing. These include radio, tape recordings, phonograph records, sound films, and filmstrips. They offer the teacher additional opportunities for meaningful science lessons.

Television is a valuable teaching aid and can do much toward furthering the objectives of science teaching. The teacher should consult the TV guides provided by the Board of Education, and plan to use television as an *integral part* of her science program.

A teacher occasionally may use audio-visual materials to introduce a new unit or topic. Such use serves to stimulate the interest and curiosity of the children and helps them formulate the problems they will try to solve. Audio-visual materials may be used during the exploration of a unit or topic to supply information needed, to reinforce knowledge or skills, to stimulate research, and to encourage follow-up activities. These aids may also be help-

ful at the end of a unit provide a review, or as part of a unit's culmination.

Audio-visual aids in science are primarily for instruction. Films and filmstrips are most effective when they can contribute specifically to the topic which is being studied. It is important that they be within the understanding of children of the grade and age level. It is not necessary that filmstrips be shown in their entirety; only those frames that are pertinent to the unit need be used. Projectors should be tested ahead of time, to make sure that they are in working order.

If the children are adequately prepared for the material to be presented, and are stimulated to be active participants, the learning is more effective. There should be ample opportunity for language training, oral and written. Children should be prepared for the new words anticipated by the teacher.

A follow-up program reinforces the knowledge and skills learned from the film, filmstrip, or other audio-visual material. This may take the form of creative writing, art work, trips to zoos and museums, making collections, reading in science books, and making reports.

A list of films and filmstrips appropriate for the science topics in Grades K-2 will be found in pages 246-56 of this handbook.

USING NEIGHBORHOOD RESOURCES

New York City is a wonderful laboratory for the study of natural science. Within the five boroughs such places as an ocean front, a bay, a waterfall, a river, and a swamp may be explored. Almost any neighborhood has a hill, a valley, a vacant lot, rocks, soil, plants, and animals. The school building itself, with its natural and man-made stone, reveals how man uses some of nature's resources. The schoolyard, exposed as it is to sun, wind, and rain, is an exciting place for observing the forces of nature at work. The trees on the street announce the changing seasons. The street becomes a "rainshed area" and the gutter a "river bed" whenever it rains. Sparrows, gulls, squirrels, and insects are among the wild animals that may be observed. A host of others abounds in nearby parks and beaches. The surface of the City reveals its past; its rivers, lakes, rocks, and stones bear evidence of the glaciers which advanced over it until some 25,000 years ago. Placed as it is on the great Atlantic flyway, one of four main paths taken by migrating birds, New York City is a stopover for many of them.

In keeping with the principle that science for children should be rooted in first-hand experiences in the real world, neighborhood trips form an essential part of the science program. In this real world children see *real* buildings going up, *real* machines at work, *real* changes in the seasons, *real* sun and clouds, *real* hills and valleys.

The following guidelines for trips are suggested:

1. There should be a good reason for making the trip, and children should know the reason.
2. There should be planning for safety, transportation, time schedule, collecting, note-taking, permissions.
3. The teacher should make a preliminary trip to determine the suitability of the place to be studied.
4. There should be group discussions about conduct and courtesy on the trip.
5. There may be some division of specific responsibility with respect to observing, collecting, and other simple duties.
6. Do not hurry children. A second trip to the same locale is often essential.
7. Follow-up after the trip may include discussion, displays, and reports.

Many trips are suggested in this handbook. The Curriculum Report, *Operation New York*, gives fuller descriptions of walks which may be taken to explore neighborhood resources, such as those which follow.

1. A walk to study natural and man-made rocks and their uses, in and around the school building and in the immediate neighborhood. For example, various kinds of colored stones, rocks of different textures and appearances, concrete, pebbles, and cut stones for driveways, colored-glass store fronts, plaster, and even porcelain (baked clay) sinks and tile in hallways.
2. A walk to discover hills in the neighborhood.
3. A trip to see the continuous natural process of building up and tearing down. This includes the erosion of soil which forms gullies and exposes the roots of trees, the rusting of iron, the expansion and cracking of sidewalks and stones, the decaying of leaves and the breaking of dead twigs.
4. Visits to locations around the school where one can study seasonal changes of trees, shrubs, hedges, flowers, buds, weeds, seed pods, leaves, lawns, and vines.
5. Surveying the neighborhood to see at first hand the surprising varieties of animals found in a city, and the tenacity and abundance of such life. Included are birds, furry animals, insects, and fish.
6. Investigating buildings under construction, studying uses of various materials, tools, and vehicles.
7. A picnic in a park where children can learn about a lake, swamp, woods, waterfalls, flowers, and trees.
8. A visit to the harbor.
9. An outing to a sandy ocean beach for dozens of fascinating observations and discoveries.
10. Walks to discover and explain sounds and odors in the neighborhood.
11. A walk to see machines at work in the neighborhood.
12. A walk to see the different forms of transportation in the neighborhood.
13. A walk to see different forms of artificial light in the neighborhood.

THE SCHOOL GARDEN IN THE SCIENCE PROGRAM

The school garden is an outdoor classroom for science education. Here children can observe living plants in a natural environment of soil, sunlight, air, and water. It is a laboratory where children discover what plants need in order to grow, how plants change as they grow, how long it takes different plants to mature, how plants grow under different conditions, what happens when plants are too crowded, how plants change as the seasons change.

For city children especially, the school garden is a place for many surprises and delights. Foods such as beans and peas, which may have been seen coming only from a can or a frozen-food package, are now seen growing and ripening on living plants. A salad made in the classroom from radishes and lettuce freshly harvested by children from their own garden is a rare treat. Carrots, turnips, Swiss chard, spinach, and peanuts are some of the other food plants which are easily grown in school gardens. There may be a harvest of the spring planting in June, or of the summer planting in September. Not to be overlooked is the esthetic appeal of the exotic aromas and rich colors of garden flowers.

As children work with garden tools they learn about their proper use and care. They find out about the value of the hoe in breaking lumps of soil, of the rake for removing pebbles and stones and for smoothing the soil, of the sprinkling can (younger children) and the hose (older children) for watering the soil.

Areas other than science are enriched by gardening experiences. One of the most valuable experiences is that which leads to improved interpersonal relationships. Recognition and understanding of a fellow planter's needs and desires grow as a gardening project develops. The school garden is also a laboratory in language arts, providing as it does a common basis for interchange of ideas, for discussion and writing of plans, and for recording the observations that follow. Some mathematics is used in planning and laying out the rows, and in measuring the growth of plants.

The school garden is a place where children observe the forces of nature at work. A downpour of rain makes gullies and washes away some of the precious topsoil; a drought dries the soil and makes it dusty, and causes the plants to wilt and droop. Children note that plants in the sunny part of the garden grow differently from those in the part which has less sunlight.

The school garden is a great teacher. Here children learn the dependence of man on plant and animal life and on the relation of this life to air, sun, soil, and water. And when children see that what *they* do makes a difference, they have learned one of the prime concepts of conservation.

EVALUATION

Evaluation is an integral part of the learning process. It starts when teaching starts, and goes on long after a lesson or unit is completed. "Success" is revealed to the teacher by many signs. It may be simply the gleam in children's eyes or the smile on their faces. In early childhood, it may be the painting and blockbuilding that children engage in following a science experience. It may be children's capacity to put a science principle to work in a new situation. It may be the number and kinds of questions that children ask. It may be their answers to such questions as, "What are we trying to find out?" or, "What did we learn?" It may be their skill in manipulating materials, their involvement in long-range projects. It may be what children do after they leave the school building: the hobbies they pursue, the games they play, the books they read, the toys they buy, the radio and television programs they observe.

Science is both knowledge and process. It consists of *knowledge* in the form of facts and principles; it consists of the *processes* employed by scientists: hypothesizing, experimenting and generalizing. Science teaching is concerned with both of these characteristics. We are concerned, for example, with a child's knowing *that outdoor shadows change* in a certain way during the day and with his knowing *how to find out that they change*. It follows that our evaluation of science teaching must take both of these facets into account. Since it is difficult to conduct tests for the *processes* of science, it is necessary for the teacher to employ other methods of evaluation, as indicated in the foregoing paragraph.

In the kindergarten topics, the teacher will find the sections, *Children As Discoverers* useful for evaluation. For Grades 1 and 2, the *Evaluative Activities*, which follow each of the topics, may be used as models by teachers.

It should be emphasized again that evaluation takes place all the time, not merely at the completion of a topic. *Evaluation serves as a sensitive instrument to guide the process of learning, moment by moment.* This Handbook is designed to foster evaluation as a built-in characteristic of teaching and of learning.

The following are some significant objectives and goals that the science curriculum is designed to promote. For the purposes of evaluation, *objectives* may be defined as the short-termed and limited aims of a single topic or portion of the curriculum. *Goals* are here defined as the long-term and broad-scoped aims of the entire science curriculum.

Objectives	Goals
Can children:	*Are children:*
1. set up experiments	1. increasing their interest in science
2. state the problem	2. increasing their awareness of their environment
3. suggest ways to solve a problem	3. reading science periodicals and books
4. manipulate materials	4. engaging in science activities on their own
5. record data	5. developing keener observation
6. interpret data	6. seeking answers to their own questions
7. generalize from the results of an experiment	7. distinguishing fact from fancy
8. state new concepts	8. beginning to expect order and predictability in relation to natural phenomena?
9. apply these concepts?	

PLANNING FOR YOUR YEAR IN SCIENCE

Many teachers have asked for suggestions in planning their year in science. There can be no *one* way of scheduling that will apply to all teachers and children, since the placement, depth, and duration of any science topic depends on so many variables: pupil interest, maturity, experiential backgrounds, language difficulties; on unexpected and unusual happenings. Thus a new building excavation in the neighborhood will certainly influence the scheduling of the Grade 2 study of rocks and soil.

There are, however, certain constants which the teacher can depend on in planning science: the logical sequence of science concepts, the sequence of themes which have been planned in other curriculum areas, the changing seasons, holidays and other special days.

The sample schedules shown here reflect some of the constant factors which enter long-range planning. The teacher may use these as a guide, but should design her own so as to include the variable factors that enter into her own situation. Note that a topic may be taught in its entirety, without a break, or that it may be sub-divided into several sub-topics, to be taught at different times during the school year. It should also be noted that science may occur without formal scheduling. For example, in Grade 2, daily weather changes may be noted, although weather is not a Grade 2 topic in this handbook.

To summarize, the science schedule planned for the year should be structured to serve as a useful framework, but flexible enough to meet the special needs of children, and to make the most of the unexpected and the unusual.

SAMPLE SCIENCE SCHEDULES

KINDERGARTEN	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
Spaces and Places	X									
What's Alive?	X									X
Discovering with Our Senses		X								
Discovering with a Magnifying Glass			X	X	X	X	X	X	X	X
Uphill and Downhill		X				X				
Seeds and Fruit			X					X		
Heat Changes Foods			X			X			X	
Sounds Around Us				X						
Light and Dark				X						
Getting Wet and Drying					X					
A Magnet Holds On					X					
Water Does Many Things							X			X
After It Falls								X		
Seesaws and Balances									X	
Blowing Bubbles										X

GRADE I	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
Weather From Day to Day	X	X	X	X	X	X	X	X	X	X
Animals and Plants in Our Neighborhood										
Animals in Our Neighborhood	X	X							X	X
Plants in Our Neighborhood	X	X							X	X
Making Sounds			X	X						
Moving on Land and Water										
Rolling Along							X			
Floating Along								X		

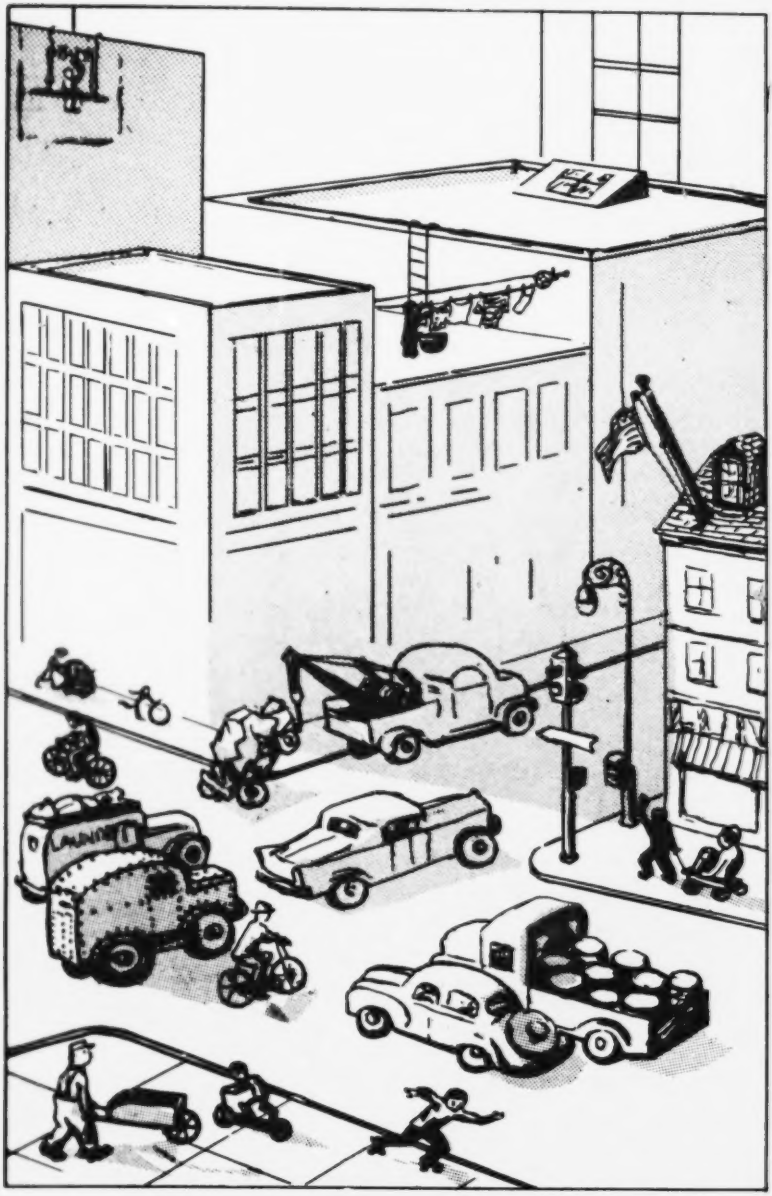
GRADE II	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
Animals and Plants in the Classroom										
Animals in the Classroom	X	X							X	X
Plants in the Classroom	X	X							X	X
Sunlight and Shadows		X	X							
Magnets				X	X					
Water, Soil Rocks and Air										
Water Around Us						X				
Soil Around Us								X		
Rocks Around Us									X	
Air Around Us										X
Moving in the Air										
Flying Along								X		

SEQUENCE OF SCIENCE TOPICS IN KINDERGARTEN, GRADE 1, AND GRADE 2

The following table indicates the specific topics which are developed in the Kindergarten, Grade 1, and Grade 2, in seven areas of science.

Area	*Kindergarten*	*Page*	*Grade 1*	*Page*	*Grade 2*	*Page*
Magnetism and Electricity	A Magnet Holds On	80			Magnets	196
Earth in Space	Spaces and Places Light and Dark	28 71			Sunlight and Shadows	187
Living Things	What's Alive? Discovering With Our Senses Seeds and Fruits Discovering With a Magnifying Glass	32 38 54 44	Animals and Plants in Our Neighborhood	135	Animals and Plants in the Classroom	171

Sound and Light in Communication	Sounds Around Us 63	Making Sounds 149		
Weather		Weather From Day to Day 106		
Motion and Force in Transportation	Uphill and Downhill 48 Seesaws and Balances 95	Moving on Land and Water 156	Moving in the Air 236	
Earth and Its Resources	Heat Changes Foods 59 Getting Wet and Drying 75 Water Mixes with Foods 84 After It Falls 90 Blowing Soap Bubbles 100		Water, Soil, Rocks, and Air 211	



Kindergarten

Science in the Kindergarten

Purpose

The program in science for the kindergarten is part of the total science program in the elementary schools in New York City.

One of the principal aims of the current revision is to improve the teaching of science as *inquiry*, as *exploration*, and as *discovery*. The decision to initiate a kindergarten science program, as distinct from the previous merged K-2 program, was based on the following considerations.

- The kindergarten has a tremendous potential for science which has not been tapped sufficiently in the past.
- Participation in carefully designed science activities at the kindergarten level provides a rich reservoir of experiences upon which to build a sound understanding of basic scientific concepts in the elementary grades.
- The introduction of science activities in the kindergarten, because of their concrete nature, will help children adjust to their immediate environment more readily.
- The science program enriches other curriculum areas.

Certain practical considerations were also considered important.

- Numerous requests for a breakdown of K-2 materials into K, 1 and 2 have come from teachers, supervisors and science coordinators.
- 80% to 90% of the eligible children will soon be going to kindergarten; many children are now having pre-kindergarten schooling.

Setting of the Program

The kindergarten offers a unique and rich setting for science. Its many areas and materials — paints, paper, clay; the play area; its blocks, toys, musical instruments; its wood and the tools for working with wood—make the kindergarten a wonderful laboratory for science.

The science program is based on the real experiences which children have in their total kindergarten program. It is an integral part of that program and utilizes the daily experiences and routines, the centers of interest in the room, and the changing seasons as resources for science.

The science program is based on the theory that kindergarten children are intensely interested in themselves and in their immediate environment. This interest is communicated in various ways: through dramatization, verbalization, block-building, art, music and other forms of creative expression.

The science *content* of the kindergarten is part of the total science program: it opens up such areas as magnetism, the earth, space, living things, the nature of materials, sound and light, weather phenomena, motion and force, by providing many experiences in these areas. These form the basis for later science interests and knowledge.

The science *methods* of the kindergarten program have much in common with those of the working scientist: they include the sensing of problems, the making and testing of hypotheses, the making of observations, reporting, and the formulation of generalizations.

The kindergarten science program is intended to help give children new perceptions of matter, a sense of space, a sense of time, and a sense of number.

Organization of the Program

The science curriculum organizes the many experiences which children have, or can have, into topics which help them *discover relationships* between these experiences, which help them *formulate simple science concepts* growing from these, and which make them *become aware of the method used for discovering.*

The theme of each topic is an invitation to exploration. It is suggestive but not restrictive: thus the titles themselves, such as *Uphill and Downhill, Getting Wet and Drying, Discovering With Our Senses, Seesaws and Balances, Seeds and Fruit,* serve as triggering devices to liberate a flow of ideas and activities. Each theme is developed through a series of questions. It is expected and intended that children and teachers will follow these main leads, and go off on many sidepaths from them.

Approaches to Teaching

The kindergarten program is not based on any single method of instruction, or of class management. As in other kindergarten curriculum areas, children work alone, in small groups, or with the entire class. The teacher is guided by the knowledge that to a great extent, kindergarten children "learn on their feet, not on their seat"; that the interests of young children are fleeting and individualistic; that immediacy of experience is vital. Thus the wind is not studied on a calm day; the opportunity is seized when in fact it is windy.

Science is not just something that happens in a certain corner, or at a particular time. It pervades all experiences and happens all the time. The teacher's role is both to use the opportunities which present themselves, and to provide the setting in which science questions will arise.

This is not haphazard science, even though it may be informal and sometimes based on experiences already planned for in relation to areas other than science. The topics are designed to help the teacher organize the potentialities in the variety of experiences of kindergarten children into a meaningful entity. The teacher should take the children in on the design. They should *be aware* that they are exploring and finding out by testing and experimenting. In this way the experiencing and experimenting contribute to the child's growing understanding of the nature of science.

Other approaches to the kindergarten science program are given in the general introduction to this handbook.

Spaces and Places

Background

Children are growing up at a time when their relationship to the earth and the universe are becoming increasingly significant.

Using the classroom as a base reference, we can orient the child to his immediate surroundings, and thereby pave the way to a better understanding of space and space travel.

The experiences suggested here will help the child to distinguish between nearer and farther, up and down, sooner and later.

Concepts

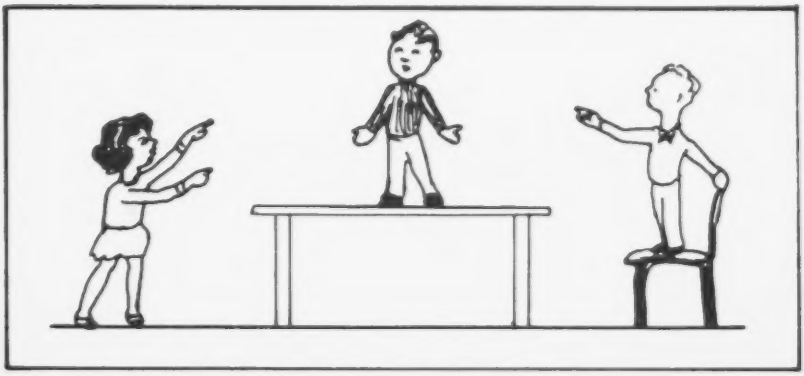
From the activities suggested, children learn the following.

We are nearer to some things than to others.

We are farther from some things than from others.

Moving faster gets us there sooner.

Up and down depends on where you are.



1. Where is your table in the room?

Have children look around the room. Ask them where they are in the room. They may say such things as: "I am next to Johnny," "I am near the teacher," "I am near the blackboard."

Direct their thinking by orienting them in the room to one object, such as the door. Ask them, "Which table (of children) is nearest to the door?" "Which table is farthest from the door?" Repeat the questions using a different point of reference in the room, such as the blackboard or windows.

- *We are nearer to some things than to others.*

2. Who will get there first?

Set up a race between two children. One child will walk, the other will run. Ask the other children to predict which child will reach the finish line sooner. Children give several reasons for their predictions. The race is run and the children see if their predictions were correct.,

- *Moving faster gets us there sooner.*

3. How can you go from here to there with the fewest steps?

Mark off a definite distance in the room, such as the distance between the door and the opposite wall. Have one child walk the distance by placing one foot directly in front of the other, while the rest of the children "sound off" by clapping as each step is taken. Have another child walk the same distance taking giant steps as the children "sound off" again.

Ask the children to compare the two methods of walking, and to name the child who used fewer steps to cover the same distance.

To reinforce this learning have children play the game *Giant Steps.*

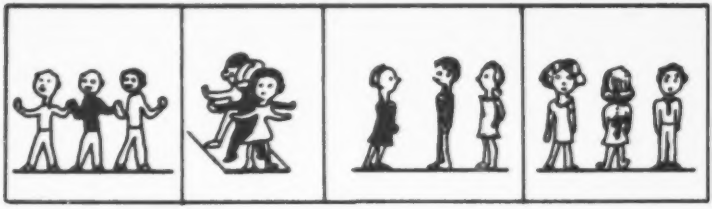
- *Fewer giant steps than small steps are needed to get us from here to there.*

4. What is in front of you in the room?

First have the children point to the front and back of their bodies. Then ask children to look in front of them and tell what they see. Ask children to glance behind them. Ask them what is in back of them.

- *Some things are in front of us; some things are in back of us.*

•Statements set in italics and following bullets are understandings which may result from the activities.



5. How can we make straight lines with three children?

Select three children and ask the others to suggest a way of placing these children in a straight line. Some children may suggest placing one behind the other. Using this formation, ask each child in the line who is in front and who is in back of him.

Children may suggest placing them shoulder to shoulder, all facing the same side of the room. Ask each child in the line who is in front and who is in back of him. (No one). Children learn that a straight line may also be made by having children stand next to each other.

The children may invent ways of lining up so that they are in a straight line but not all facing the same way.

- *Children can stand in straight lines in different ways.*

6. What is high in the room? What is low?

Ask one child to put one hand on his head and the other hand on his hip. Which hand is higher up? (The hand on the head.) Which hand is lower down? (The hand on the hip.)

Select three children who are approximately the same height. How can we get one child higher than the others? (Stand on a chair.) How can we get one child higher than the one on the chair? (Stand on a table.) Ask the child standing on the floor: Who is up from you? (The child on the chair and the child on the table) Who is down? (No one.) Ask the child standing on the chair: Who is up from you? (The child on the table.) Who is down? (The child standing on the floor.) Ask the child standing on the table: Who is up from you? (No one). Who is down? (The child on the chair and the child on the floor.)

Ask the children: How high up can you go in this room? How high up could you go if there were no ceiling?

How far down can you go in this room? Have the children put their hands flat on the floor. Are they all the way down? If there were no floor, how far down could your hands go?

Have children locate things in the room which are higher and lower than themselves. What things in the room are higher? (Ceiling, lights, pictures.) What things in the room are lower? (Floor, chairs, toys.)

The concepts of up and down may be reinforced in the playground when children are on equipment such as slides, seesaws and jungle gyms.

- *Some things are higher in a room than we are.*
- *Some things are lower in a room than we are.*
- *Things above you are higher than things below you.*
- *Up and down depends on where you are.*

ORAL VOCABULARY

away	count	high	run
back	down	large	shoulder
ball	different	line	size
basketball	face	look	small
behind	far	low	soon
block	fast	many	step
body	few	move	straight
ceiling	finish	near	table
chair	floor	next	there
change	front	open	up
clap	game	race	walk
close	giant	reach	where
	here	room	

CHILDREN AS DISCOVERERS

Observing Problem 1. Children observe which objects are near the door and which are far from it.

Predicting Problem 2. Children are asked to predict who will win the race: the walker or the runner.

Comparing Problem 2. Children compare running with walking.

Measuring Problem 3. Children "sound off" (by clapping) small and "giant" steps taken to walk a distance.

What's Alive?

Background

Children are fascinated by living things. They are especially interested in watching animals to see how they move and eat. One of the objectives of this topic is to help children come to the realization that animals breathe, grow, and protect themselves. Another objective is to have children understand that plants, also, are alive.

A visit to an outdoor environment initiates the topic. Here the question, "What's alive?" is raised but not immediately answered. In subsequent indoor activities, children observe various animals and plants to discover some of the characteristics of living things. A return visit to the outdoor environment gives the opportunity to evaluate their learnings.

Concepts

From the activities suggested, children learn the following.

There are many kinds of living things.

Animals move, eat, breathe, grow, and protect themselves.

Plants are living things.

Living things change as the seasons change.

1. What is alive out here?

Take a trip to a place where there are living things such as an area of street trees, a school garden, a vacant lot, a neighborhood lawn or garden, a park pond, lake or lawn.

What can you see that is alive? Children look intently and name some of the things which they think are alive. They may discover ants and earthworms in the soil; caterpillars and beetles on trees; birds, squirrels and other living things. If the children do not suggest plants in their survey, the teacher should ask them whether or not they should be included. Make a list of all the animals and plants mentioned by the children. Include inanimate objects, also, if children propose them.

The question of whether the things listed are living or non-living need not be decided on this initial trip. The problems which follow will give children some criteria for determining what is alive. After engaging in the activities related to these problems, a subsequent trip may be taken, so that the children may apply these criteria to the things they will see in a natural environment.

- *There are many kinds of living things.*

2. Is a turtle alive?

Children observe the (living) turtles which they have in their classroom. Are they alive? How can you tell? Some answers may be: they move; they eat; they climb; they swim; they pull their heads in.

Have children compare one of the living turtles with a toy turtle (preferably one with a moving head and tail) and tell about the similarities and differences in the two.

Have a child touch the head of the live turtle lightly. Then touch the head of the artificial turtle. The live turtle will pull its head into its shell, the artificial turtle will not.

Have children explore further by gently picking up the live turtle and the artificial one to see how the live turtle protects the exposed parts of its body. Have them observe the throbbing in the throat of the turtle. This is a breathing movement.

Children compare the responses to food of the living and non-living turtles. They also place both turtles in an aquarium with water. What happens to each? *Note:* Provide a small rock rising out of the water onto which the live turtle may climb, if you plan to leave it there any length of time.

- *A live turtle eats, swims, breathes, moves itself, protects itself.*

3. Is a fish alive?

Children observe the fish in the classroom aquarium. They comment on the way the fish moves; its breathing (indicated by the opening and closing of its mouth); the way the fish eats (observed after food is sprinkled into the water).

A trip to a nearby pet shop will give children an opportunity to see a variety of fish.

- *A fish moves, breathes and eats.*

4. Is a pet (dog, cat, bird) alive?

Following the same general procedures indicated in the preceding problems, children observe the animal being discussed and comment on the characteristics which indicate that it is alive.

Note: The number and variety of animals observed in the classroom may be augmented with the help of the children's parents. Following is a sample letter to the parents for this purpose.

Dear Parents,

This month my classes will be working on a special science topic called, *What's Alive?* I expect to keep some goldfish, a turtle, and other small animals in the room for the children to observe. In addition, I should like to extend a cordial invitation to you to bring your child's pet to our class. As a safety measure only parents (*not* children) will bring pets to school for an hour or so. Please do not bring pets unless we have arranged an appointment for its visit. Before doing so, however, please answer the questionnaire below and return it to me.

Thank you.

Sincerely yours,

1. Do you have a pet at home? ——— What pet? ————
2. Would you be willing to have your child show it at school? ———
3. Do you know anyone who has a pet shop we can visit? ————
4. Do you know anyone who has a pet he would be willing to show?———

- *Pets move, breathe, eat, protect themselves, and grow.*
- *Pets need good care.*

5. Are insects alive?

Even in a city environment children will have experience with a variety of insects during the school year. Some of these insects may be caterpillars, beetles, ants, butterflies, moths, grasshoppers, crickets, praying mantises, houseflies, and mosquitoes. As many different insects as possible should be brought into the classroom. Food should be provided and they should be housed in suitable ventilated containers.

Children observe the insects for some period of time and comment on the characteristics which indicate that they are alive. They note particularly the feeding habits and the methods of locomotion of these insects. In the case of caterpillars, they may observe growth, and also the change into a cocoon (moth) or chrysalid (butterfly). *Note*: Harmless insects should be released, after observations are concluded, into the environment from which they came.

- *Insects eat, move and grow.*

6. Is a plant alive?

Prior to this, children have observed and participated in the care of the different plants in their classroom, such as philodendrum, geranium, begonia, pothos, ivy, and grass. They also have planted pea, bean, radish and pumpkin seeds.

Select a rapidly growing seedling such as bean, pumpkin, or tomato. How do we know it is alive? Some children may suggest that it has been growing. How can we be sure that it grows? Children may suggest measuring and recording growth. Insert a dowel or other stick in the soil with the plant. Mark off the starting height of the plant. Make similar markings each week for the next three weeks. Water the plant regularly. Children note the growth of the whole plant. They may notice the growth of the individual leaves.

In the spring when trees are bare it might be interesting to ask: Is this tree alive? Have the children observe the tree periodically for a number of weeks and note the changes that take place.

- *A live plant grows.*

7. Are you alive?

One child who thinks he is alive serves as the "laboratory model" of a living human. Is he alive? How do you know? Some answers may include: he talks; he breathes (determined after placing hand on his chest); he protects himself (after someone makes a sudden move toward him and he moves back to protect himself); he moves his eyes.

How else can you tell that he is alive? Children may say: he eats (after he is given a cookie); his heart beats (determined after placing an ear to his chest); he grows.

How can we tell that he grows? Some children may suggest various ways of measuring his height and keeping a record. One way to do this is to fasten to a wall a strip of paper held vertically. Cut it to the same length as the height of the child being measured. Enter the date of the measurement on each strip. Other children may suggest weighing him and keeping a record. This record may be entered on the same chart where the height is recorded. Repeat these measurements from month to month.

Children enjoy making a comparison between a child and a life size doll for similarities and differences.

- *A child moves, eats, breathes, protects himself, and grows.*

8. What is alive out here?

Revisit the environment selected in Problem 1. Read to the children the list of things they thought were living on their first trip here. Have them take a fresh look at the environment and decide what things to retain, add or delete. Of course, the difference in the season may account for many of the changes observed and thus influence their decisions. Ask children, in each case, how they decided whether or not a thing is alive.

- *There are many kinds of living things.*
- *I can find different living things in different seasons.*
- *We know that something is alive if it moves, eats, breathes and grows.*

ORAL VOCABULARY

alike	dog	head	plant
alive	doll	height	pond
aquarium	earthworm	leaves	protect
bean	eat	leg	seed
bird	egg	measure	shell
breathe	fish	moth	soil
cat	flower pot	mouth	stem
caterpillar	food	move	tail
chrysalid	garden	park	toy
cocoon	goldfish	pebble	turtle
different	grow	pet	weight

CHILDREN AS DISCOVERERS

Observing Problem 1. Children find living things in an outdoor environment.

Classifying Problem 8. Children separate things into living and non-living groups.

Comparing Problem 2. Children compare a living and a toy turtle.

Measuring Problem 7. Children measure the growth of a child.

Problem 6. Children measure the growth of a seedling.

Recording Problem 6. Children record the height and weight of a child.

Problem 6. Children record the height of a plant.

Reporting Problem 1. Children tell about the objects seen in their survey of an outdoor environment.

Applying Problem 8. Children relate their learnings to evaluate an original listing of living and non-living things.

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Everybody Eats — Mary B. Greer
The True Book of Insects — Illa Podendorf
Birds' Nests, Turtles and Fish — Shakelford, et al.
See How It Grows — M. Walters
Wonders of Nature — Jane Watson
Travelers All — Irma E. Webber
Up Above and Down Below — Irma E. Webber

*Complete annotations for these books, and other books related to this topic, will be found on pages 257 to 265.

Discovering With Our Senses

Background

What are our senses? We have eyes for seeing, ears for hearing, tongue for tasting, nose for smelling, and skin for touching. Research indicates that other senses help a person know and react to his surroundings. These include sensing differences in weight through lifting things, feeling pain and hunger, and maintaining balance.

Since the senses are the keys to investigations in science, the chief aim of this unit is to help children develop skill in using their senses as tools of discovery.

As children become engaged in the games and other activities which follow, they not only *use* their senses but *become aware* that they are using their senses to find things out.

Concepts

From the activities suggested, children learn the following.

We find out about the world around us by seeing, hearing, smelling, touching and tasting.

Seeing is one way of finding out; we see with our eyes.

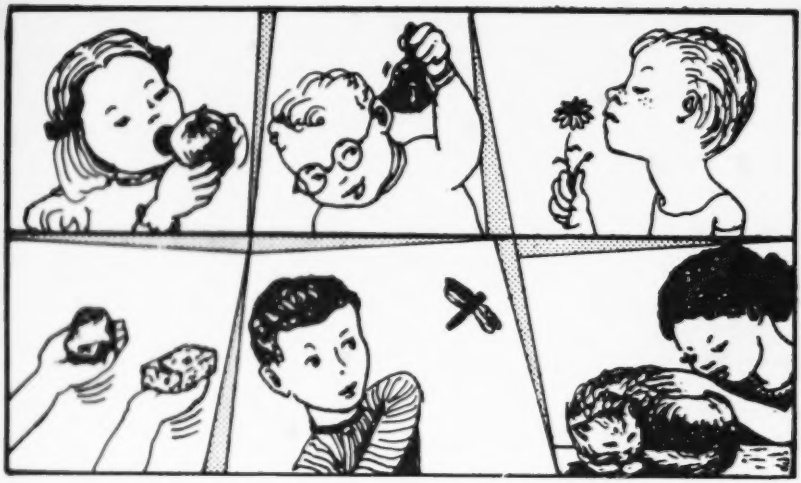
Hearing is one way of finding out; we hear with our ears.

Tasting is one way of finding out; we taste with our tongues.

Smelling is one way of finding out; we smell with our noses.

Touching is one way of finding out; we touch and feel with our fingers and our skin.

Lifting is one way of finding out; we lift with muscles in our arms.



1. What's in the bag?

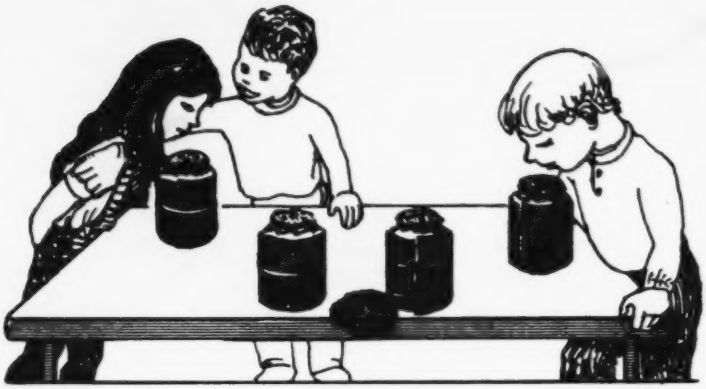
The objects used in this game should be those which children have observed previously, such as blocks, balls, sandpaper, rocks, sponges, rhythm instruments, articles of clothing, toys, foods. Children will think of others to use as the game continues.

Place several of these objects inside a large paper bag. A child is blindfolded and asked to select one object from the bag and tell what he thinks it is. While he is trying to determine what it is, he should be encouraged to squeeze it, rub it, shake it, smell it, lift it, and to use descriptive comments such as "It feels heavy," "It's bumpy," "It rattles," "It feels soft."

After the child has had his guess, the blindfold is removed. Another child is then asked to come up and continue the game by selecting a second object. The children begin to understand that they can identify things by using their senses.

When the game is over, place the bag with the objects in it, and others which may be added, on a table so that the children can try this themselves.

- *We find out what things are by seeing, listening, smelling, touching and tasting.*
- *We can tell what some things are even when we cannot see them.*



2. What does your nose smell?

Prepare a series of "smell" jars. Into each place such things as a piece of onion, apple, orange, green pepper, cucumber, some perfume, flower petals or leaves, cheese, garlic, fresh bread, and others. Paint the sides and the bottom of the jars or cover them with construction paper. Thoroughly cleaned, empty milk cartons may be used instead of jars. Cover the tops of the containers with aluminum foil, secure with rubber bands, and perforate the foil with small holes.

Ask: How can you tell what is in the jar without taking it out? Some children may suggest sniffing. Pass one jar around so that each child may sniff it. Ask: What can you find out with your nose? After the children have made their guesses take the contents out of the container. Repeat this with the other "smell" jars.

Replace all the contents in the jars and place them on a table where the children may later conduct their own smelling tests.

- *We smell with our noses.*
- *We can tell what some things are by smelling them.*

3. What can you tell with your fingers?

Place the following objects in a covered box or bag: piece of fur, block, ball, sandpaper, writing paper, wool, cotton, rocks (smooth and rough), a moist sponge, a metal spoon. Have a child hold a single object, with his hand still in the bag, and describe how it feels. Ask: Is it smooth or rough? Is it soft or hard? Is it warm or cold? Is it wet or dry?

After the child has responded to the questions, ask him to guess the

name of the object. Then have him take the object out of the bag and pass it around so that all may feel it.

- *We can tell what some things are by feeling them.*

4. What happens when you cover your ears?

Ring a bell behind a screen. Children listen and try to guess what is making the sound. Then show the bell and ring it in full view of the children.

Ask children to cover their ears with their hands. Ring the bell again behind the screen. Children discover that none of us hear as well when our ears are covered.

- *We hear with our ears.*
- *We hear better with uncovered ears.*

5. What can you find out with your ears?

Note: Children should have listening experiences before engaging in this game. The teacher should select familiar sounds which occur frequently in the kindergarten environment.

In the following game children are asked to guess what makes the sound.

Let one child at a time stand behind a screen and

shake a maraca	crumple paper	pop a balloon
turn an egg beater	pour water	blow a whistle
sweep with a broom	saw wood	toot a horn
use a pencil sharpener	ring a bell	hammer a nail.

After the object is identified (or, in some cases, mis-identified) it should be sounded again in full view of the children.

- *We hear with our ears.*
- *We often can tell what is happening by listening carefully.*

6. What can you find out with your tongue?

Prepare a series of items suitable for tasting. Include such familiar (and some relatively unfamiliar) things, such as bread, apples, dates, raisins, plums, peaches, raw peas, carrots, cucumbers, tomatoes, various fruit juices, milk, jello, and gelatin desserts.

Place a small amount of each food item in a paper cup and place all of the paper cups on a tray held above the eye level of the children. Blindfold a child and have him taste the item in the paper cup and guess what it is. The child and the class then take a look at it.

Odor plays a part in tasting. Actually, the tongue can detect only sweet, sour, salty, and bitter tastes. To eliminate the influence of odor, play the game again but have the blindfolded child hold his nose while tasting. Children realize that tasting helps, but smelling is also helpful in naming an object.

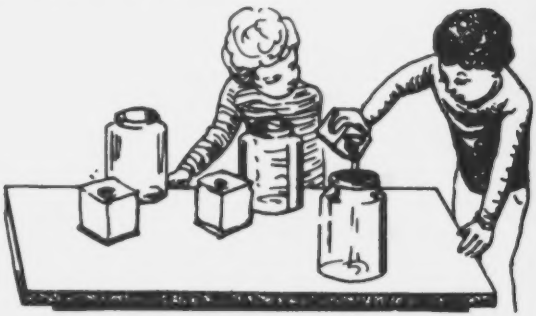
- *We taste with our tongues.*
- *Sometimes tasting helps us find out what a thing is.*
- *Smelling also helps us to know what we are tasting.*

7. What can you find out with your arm?

Prepare three milk containers which are filled with a varying amount of *one* fairly heavy substance, such as water, pebbles, sand, beads or marbles. Let one container be empty, one half full, and one full.

Tell the children that the three containers are filled with different amounts of the substance being used and ask them how they could tell, without looking, which one has the most.

Lifting things helps us know; measuring makes us sure.



Children may suggest picking each one up to discover which container feels heaviest. (Mark it red.) Which feels less heavy? (Mark it blue.) Which feels lightest? (Mark it green.)

Some children may suggest opening the containers and looking inside. After looking, the contents may be poured into 3 clear jars of equal size to confirm their estimate.

Other children may suggest weighing the containers on a scale. If a balance scale is available, test the accuracy of the order which has been established by comparing two at a time. The following comparisons may be made: red with blue; red with green; blue with green.

- *Sometimes we can lift things to find out how heavy they feel.*

ORAL VOCABULARY

apple	cucumber	nose	small
arms	dry	onion	smell
ball	ears	orange	smooth
balloon	eyes	paper	sniff
bell	feel	pear	spoon
blindfold	fingers	pepper	sponge
blocks	flat	perfume	squeeze
blue	garlic	raisins	table
bread	green	rocks	taste
bumpy	hear	rough	touch
carton	heavy	round	warm
cheese	know	sandpaper	water
cold	large	see	wet
container	lift	shake	whistle
cotton	light	skin	wool

CHILDREN AS DISCOVERERS

Observing — Problem 1. Children see, feel, smell and listen to determine what the objects are.

Measuring — Problem 7. Children place the contents of the containers on a balance scale to find out which is lightest and which is heaviest.

Comparing — Problem 7. Children lift the 3 containers to find out their relative weight.

Reporting — Problem 7. Children look at the contents of the 3 containers and relate their findings.

Generalizing — Problem 2. Children learn that often they can discover what is in a jar by smelling.

SELECTED BIBLIOGRAPHY*

My Five Senses — Aliki
My Hands — Aliki
Pat the Bunny — Dorothy Kunhardt
Noses Are For Roses — Phoebe
The Blind Men and the Elephant — John Godfrey Saxe
Now I Know — Julius Schwartz

*Complete annotations for these books, and other books related to this topic, will be found on pages 257 to 265.

Discovering With a Magnifying Glass

Background

Children are curious about how things look close up. A reading (magnifying) glass helps children see and explore such things as seeds, sand, leaves and their own skin under magnification.

Once children have learned how to use a magnifying glass, it can be employed throughout the year as a tool of discovery in other areas of the kindergarten science program. Children should also be encouraged to follow their own interests in using the magnifying glass.

Concepts

From the activities suggested, children learn the following.

A magnifying glass makes things look bigger.

A magnifying glass helps us see things more clearly.

A magnifying glass helps us see things we could not see before.

Sometimes a magnifying glass helps us see what is happening.

1. What can you find out with your magnifying glass?

Children explore freely in their classroom for several days with a hand magnifying glass. Without any directions from the teacher, they examine such objects as fish, turtles, pebbles, leaves, crayons, their hands, pegboards, and articles of clothing.

As children use the magnifying glass they find that they have to move it to a good position (focus) to see the object clearly. Children comment informally on their discoveries.

- *A magnifying glass makes objects look bigger.*
- *We can see objects more clearly if we bring the magnifying glass to the best seeing position.*

2. How do the holes of a pegboard look through a magnifying glass?

Children hold a magnifying glass over a part of a pegboard and comment on the size and spacing of the holes. They compare the magnified portion of the pegboard with the unmagnified area and comment on their differences.

- *A magnifying glass makes the holes of a pegboard look bigger.*
- *A magnifying glass makes the holes of a pegboard look farther apart.*

3. What do objects look like through a magnifying glass?

The chart listed below offers some examples of objects which children may explore as individuals or in small groups. These items are examined one at a time, throughout the school year, as the occasion arises.

The right hand column indicates some of the possible structural details and happenings which may be observed. The information in this column will help the teacher assist the children. Children also will make many other discoveries that are not mentioned here.

Name of Object	What We See
Skin on hand	moisture particles of dust tiny cuts wrinkles fine lines fingerprints

Name of Object	What We See
Turtle	markings on upper and lower shell eye movement scales on skin breathing movements of throat
Plants	veins in leaves, forming various patterns different parts of flowers network of tiny roots from sprouting seeds
Fish	movement of the fins breathing movement of the mouth scales
Snail	movement of the foot movement of the "feelers"
Sand	particles of different shapes, colors and sizes
Rock	colors and shapes of smaller particles (minerals)
Aquarium Plant	snail eggs on plant veins on leaves
Seeds	different shapes and texture of different kinds of seeds (round, crescent, oval, flat, smooth, rough, barbed)
Bird's Nest	materials of which nest is made (plant fibers, bits of leaves, string, yarn, mud, pebbles)
Sponge	openings in sponge (compare dry and wet sponge)
Cloth	
Dixie Mesh	holes
Cheese Cloth	threads go over and under; pattern of squares
Soil	pebbles, sand, leaves, living or dead insects

As children use a magnifying glass, the teacher can help them record their findings on an experience chart which may culminate in a class picture-story book called, *What We Saw Through a Magnifying Glass.*

- *A magnifying glass makes things look bigger.*
- *A magnifying glass helps us see things more clearly.*
- *A magnifying glass helps us see things we could not see before.*
- *Sometimes a magnifying glass helps us more easily see what happens.*

ORAL VOCABULARY

arm	hand	skin
away	larger	smooth
closer	lines	snail
down	magnifying glass	spaces
dust	object	tiny
eye	palm	toward
finger	pegholes	turtle
fish	plants	up
hair	sand	

CHILDREN AS DISCOVERERS

Observing — In all problems. Children look at various objects through a magnifying glass.

Comparing — Problem 2. Children compare a magnified portion of a pegboard with an unmagnified area.

Recording — Problem 3. Children keep a record of what objects look like through a magnifying glass.

Generalizing — Problem 3. Children become aware that objects appear larger and can be seen more clearly through a magnifying glass.

SELECTED BIBLIOGRAPHY*

Through the Magnifying Glass—Julius Schwartz

(Teacher Reference)

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*Complete annotations for these books, and other books related to this topic, will be found on pages 257 to 265.

Uphill and Downhill

Background

Hills are part of a child's world. Children exert themselves as they push their way up a hill; they run with delight on their way down. With their bodies they can feel when they are going uphill or downhill.

Children's outdoor experiences with bicycles, wagons, skates and sleds teach them some of the other characteristics of hills: that a vehicle on a hill may start moving without a push; that it may continue to roll after it reaches the bottom; that it will finally come to a stop.

As children play with objects that roll on inclined surfaces, they also become aware of the effect of a miniature "hill" on the movement of such objects. These activities lend themselves to experimentation: they try to find out how to make a ball roll for a longer distance before stopping; they discover that a ball generally will roll farther from a steeper, longer hill. In experimenting with small "hills" the children, like scientists, are setting up a working model of a part of the real world.

Concepts

From the activities suggested children learn the following.

A hill is higher at one end then at the other.

It is harder to go up a hill than to go down a hill.

A ball can roll down a hill without being pushed.

A ball rolls from the higher to the lower end of a hill.

A ball may keep rolling when it gets to the bottom of a hill.

A ball rolls farther after rolling down a long hill than a short one.

A ball rolls farther after rolling down a steep hill than a gentle one.

A push is needed to roll a ball uphill.

1. What is a hill?

Children take a trip through the neighborhood to find hills. *Note*: Explore the area beforehand to find streets on hills, or hills in parks.

Children walk up and down a hill. Ask: Which end of the hill is higher? How do you feel when you go up the hill? How do you feel when you go down the hill? Which is easier—going up or going down a hill?

- *A hill is high at one end and lower at the other.*
- *Some hills are steeper than others.*
- *Some hills are longer than others.*
- *Going up a hill is harder than going down.*
- *Going down a hill is easier than going up.*

2. How can we make a hill?

Children suggest using clay, sand, blocks, planks or other materials. Using these materials, children make hills of varying size and steepness. How do you know it's a hill? Children will offer many answers such as, "It looks like a hill," "One end is higher than the other," "One end is up and the other end is down." They test their hills with various objects: crayons, toy trucks, beads, balls.

- *We can make a hill by lifting one end of an object.*
- *We can make a hill of clay or sand by building one part higher than the other.*

3. Does a ball need a push to roll down a hill?

Children place a ball on a hill they have made, and then let go. They

observe that the ball rolls down their hill without any need of a push.

To focus attention on the slant of the hill, ask the children to compare what happens when a ball is placed on a board which is flat on the floor, with what happens when they use a similar board that is raised at one end with a few blocks.

- *A ball can roll down a hill without a push.*

4. What can we roll down a hill?

Have children make hills of blocks and planks as in Problem 2. Children are asked to suggest what they would like to roll down their hills. They may include the following: balls, cylindrical blocks, rectangular blocks, toy wagons, skates, beads, and boxes. They place each object near the top of their homemade hills and release it. Children may generalize that round objects such as pencils, balls, marbles, and beads roll down a hill, and objects with flat sides (blocks, boxes) slide down or do not move.

- *Some things roll down a hill.*
- *Some things slide down a hill.*
- *Some things do not move on a hill.*
- *Round things go down a hill more easily than flat things.*

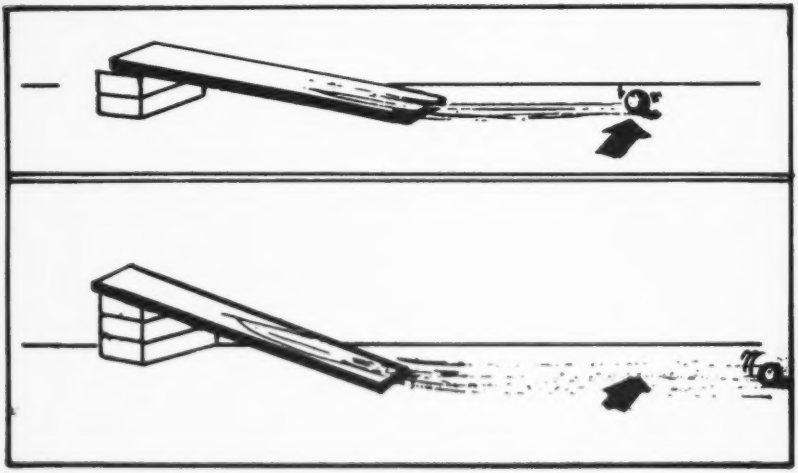
5. What happens when a rolling ball comes to the bottom of a hill?

There will be a variety of answers to this question which will necessitate another ball-rolling test. As children roll balls from their homemade hills, direct their attention to the motion of the ball as it passes the bottom of the hill. They observe that the ball continues to roll after it reaches the bottom of the hill. They observe that the ball stops on a level surface after rolling some distance. Also try other rollers: toy wagons, trucks.

- *A ball rolling down a hill will keep rolling after reaching the bottom.*
- *A rolling ball will come to a stop on a level surface.*

6. How can we make a ball roll farther?

Children roll a ball down a slope and observe where it stops. They roll a second ball down and again observe where it stops. How can we remember where the balls stop if we take them away? Children may suggest placing a marker at the stopping point or marking the floor with chalk at that point. *Note:* If rolling-space is limited, a toy truck or car may be substituted for a ball in this activity.



The steeper the hill, the farther the ball goes.

How can we make the ball roll farther? Children may offer different suggestions. Some may propose starting the ball at different places on the "hill"; others may suggest making the "hill" steeper by elevating one end. Each of these ideas should be tested separately.

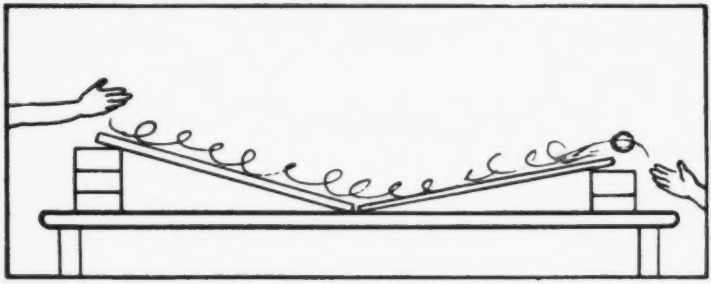
a. To test the first suggestion allow the children to start a ball at the top and again at the middle of a particular slope. Mark the stopping points and compare results.

b. Children roll a ball down from the top of a slope and mark its stopping point. They then elevate one end of the "hill" with some supports (blocks), and roll the ball from the same starting point as before. Compare stopping points.

- *A ball rolls farther when it is started near the top of a hill, than when it is started lower down.*
- *A ball rolls farther when it is started on a steep hill than on one that is not as steep.*

7. How can we make a ball roll uphill?

Children may suggest a sudden push, a steady push, or a push using a stick or other object. Then try their suggestions on homemade hills. They discover that when they give the ball a hard push, it will roll farther up the hill. In trying out various methods, children may discover that



Down one hill and up the other.

they can use one hill to make the ball go up another one. The ball rolls down one hill and up the other.

- *A push is needed to roll a ball uphill.*
- *The harder the push, the farther uphill the ball will roll.*
- *We can make a ball roll up a hill by first rolling it down another hill.*

8. Why do we have to be careful when we run or ride down a steep hill?

Take children to a hill in the neighborhood or in a park where it is safe for them to run. Mark the bottom of the hill. Have children run down the hill one at a time and see how soon they can stop, without falling, after they reach the bottom. Children discover that when they reach the bottom of the hill, they keep on moving; it is not easy to stop. Ask children to recall experiences with sleds, skates, and wagons on steep hills. Discuss the safety implications in these experiences.

- *When we skate, run, or ride down a hill, we keep on moving after we reach the bottom.*
- *We must have space to stop safely when we run or ride down a hill.*

ORAL VOCABULARY

ball	hard	roll
block	high	round
bottom	hill	sand
clay	level	slide
easy	low	slope
far	make	slow
fast	plank	steep
flat	push	stop
gentle	ramp	top

CHILDREN AS DISCOVERERS

Observing	Problem 1. Children observe that round things roll down a hill whereas many other shapes do not.
Experimenting	Problem 6. Children experiment with the effect of different slopes of hills on rolling objects.
Predicting	Problem 6. Children forecast the distance a ball will roll from different slopes.
Comparing	Problem 6. Children compare the distance covered by a ball rolling from different places on a hill.
Generalizing	Problem 2. Children generalize that when they let go of a ball on a hill, it will roll down.
Applying	Problem 7. Children apply their knowledge of rolling objects on hills to safety practices.

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The Little Engine That Could—Unknown

Believe and Make-Believe—Edited by Lucy Sprague Mitchell and I. S. Blaca

(*The Roll-Away Ball*—Ruth A. Sonneborn)

Uphill and Downhill—Julius Schwartz

Up, Down and All Around—Marguerite Waters.

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*Complete annotations and other books related to this topic will be found on pages 257 to 265.

Seeds and Fruits

Background

Children have many experiences with seeds in their homes and neighborhood. They enjoy playing with "Polly noses" (seeds of the maple tree) and seedballs of plane trees. They also find seeds in many of their foods. Some of these seeds they eat; others they do not.

Most children are familiar with the word *fruit*. They are aware that the foods they call fruit contain seeds. But they may not realize that some *vegetables*, such as tomatoes, cucumbers, peppers, and stringbeans are also fruits. The word *vegetable* refers to any edible part or parts of certain plants when prepared for the market or table. It has no exact scientific meaning, but is a useful and acceptable word when shopping or preparing a menu.

The word *fruit*, however, has a specific scientific meaning, and refers to that part of a plant which contains the seeds. Foods such as peppers, peas, and pumpkins are the fruits of their plants just as peaches, apples, and oranges are the fruit of their plants. Each of these fruits contain seeds from which new plants can grow.

By planting seeds and observing the development of new plants, children discover the important role played by seeds in the life history of a plant.

Concepts

From the activities suggested, children learn the following.

Seeds are found in fruits.

Each kind of fruit has its own kind of seed.

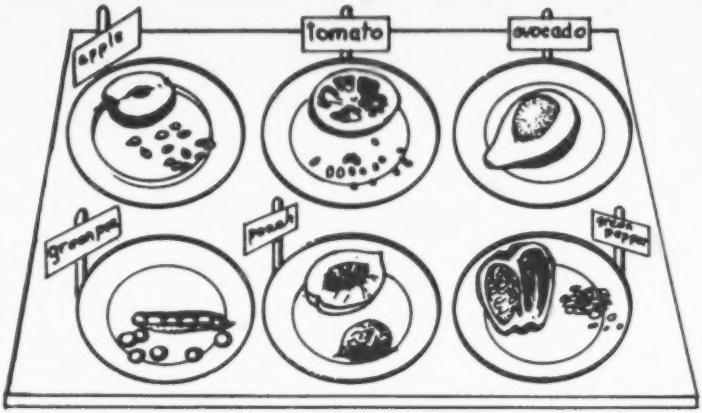
Different fruits have different numbers of seeds.

We eat the fruit and seeds of many plants.

Many plants that grow in our neighborhood have seeds.

Each kind of plant has its own kind of fruit and seed.

Under the right conditions new plants grow from seeds.



1. What seeds can we find in a supermarket?

Visit the fruit and vegetable section of a supermarket. Ask the children to suggest what things have seeds in them. Their list *might* include:

peaches	oranges	peppers
cherries	grapefruit	stringbeans
pears	peas	pumpkins
grapes	cucumbers	lemons
apples	tomatoes	avocados.

If possible, take back a sample of the things suggested, including foods that do not have seeds (carrots and radishes), if children suggest them. Say, "We will find out in the classroom," if there is disagreement.

Upon returning to the classroom, children may cut or break open the various foods to look for seeds. Children will discover that some vegetables such as tomatoes, cucumbers, and green peppers contain seeds, and are therefore fruits. Carrots and radishes, however, are not fruits, as they will realize.

Note: For such fruits as peaches, cherries, plums and apricots, it may be necessary to introduce the use of the word "seed" instead of or equivalent to "pit."

Children may keep a "record" of their findings by placing in aluminum pie plates washed and dried seeds next to the fruit from which they came. A stick with a label on it may be attached to each plate.

- *Foods that have seeds are called fruits.*
- *Each kind of fruit has its own kind of seed.*

2. How are seeds arranged in different fruits?

Show the class a variety of fruits that have been cut open to expose the seeds. Included in the group might be peaches, oranges, peas, green peppers, and cucumbers. Ask children to describe the way in which the seeds are placed in the fruit. They may note that some seeds are scattered, some are clustered, some are alone, and some are arranged in rows.

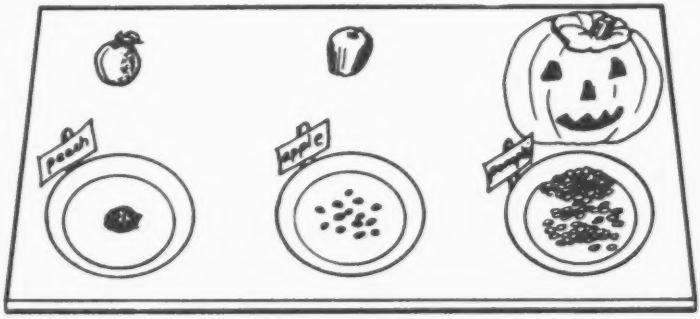
Ask children to describe the "container" itself. They may note such characteristics of the fruit as color, size, shape, odor, taste, and texture.

- *There are many ways in which seeds are arranged in fruits.*

3 How many seeds are there in each kind of fruit?

Ask the children to select a fruit which has only *one* seed in it. Allow them to verify the accuracy of their choice by opening the fruit and removing the seed from it (peach, plum, apricot).

Ask the children to name fruits which have a *few* seeds in them. (Oranges, pears, apples.) Have children open the fruit and spread the seeds out.



One seed . . . more seeds . . . a lot of seeds.

Ask the children to name fruits in which there are *many* seeds. (Watermelon, pumpkin, green pepper.) Have children open some of these fruits and spread the seeds on paper towels.

- *Some fruits have one seed in them.*
- *Some fruits have a few seeds in them.*
- *Some fruits have many seeds in them.*

4. What does a seed look like?

Have children compare the size, shape, color and texture of different seeds. Use one or two samples of each kind of seed. Encourage them to

classify their samples according to any one characteristic which they suggest. Some children may want to sort theirs in two groups according to size, *Big Seeds* and *Little Seeds;* others, in two groups according to edibility, *Seeds We Eat* and *Seeds We Do Not Eat;* and others, in two groups according to how they feel, *Hard Seeds* and *Soft Seeds*.

- *Seeds have many different sizes, shapes, colors, and coverings.*

5. What fruit did this seed come from?

Play this game with the children. Hold up "mystery seeds", one at a time. Children are permitted to examine their exhibit of fruits and seeds, if necessary, to match each unknown seed to the kind of fruit from which it came.

- *Each kind of fruit has its own kind of seed.*

6. What seeds can be found outdoors?

Take a walk to a local park or garden. Try to find seeds of trees, bushes, or small plants. If possible, show children apples or other fruits hanging on a tree.

Where seeds have fallen to the ground, they may be brought back to the classroom and compared with the exhibit of seeds the children have previously dried.

- *Many plants that grow near the school have seeds on them.*
- *Seeds and fruits are parts of a plant.*

7. What happens to seeds when we plant them?

Save the seeds from a Halloween pumpkin. Plant them in soil in clear plastic containers. Have children water them carefully and observe them daily. Compare with seeds in unwatered soil. Ask children to predict what will happen to each.

After pumpkin seeds have germinated in moist soil, have children observe and comment on the network of roots that can be seen through the container.

Show the children packages of seeds such as grass seed, birdseed or beans. (Birdseed is a mixture of many kinds of seeds.) Plant some of these seeds in soil, in pots of sand, or on sponges, bricks, or moist blotters. (See page 180.)

- *Plants grow from seeds*
- *Water is needed to help seeds sprout.*

ORAL VOCABULARY

apple	grapes	radish
avocado	grass seed	scattered
birdseed	lemon	seed
carrot	orange	soil
cherries	peach	sprout
clustered	pear	string beans
cucumber	peas	tomato
fruit	peppers	vegetable
grapefruit	pumpkin	

CHILDREN AS DISCOVERERS

Observing Problem 2. Children observe the arrangement of seeds in fruit.

Experimenting Problem 7. Children grow seeds in moist soil and dry soil.

Predicting Problem 7. Children predict what will happen to seeds planted in moist soil and dry soil.

Classifying Problem 4. Children group seeds according to their characteristics.

Comparing Problem 3. Children compare the number of seeds in each kind of fruit.

Recording Problem 1. Children make an exhibit of seeds and the fruits from which they came.

Generalizing Problem 5. Children conclude that each kind of fruit has its own kind of seed.

Problem 6. Children conclude that seeds and fruits are parts of a plant.

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About Things That Grow—Joyce Smith Eggleston

Autumn Harvest—Alvin Tresselt

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* Complete annotations for these books, and other books related to this topic, will be found on pages 257 to 265.

Heat Changes Foods

Background

The cooking experiences in the kindergarten program afford excellent opportunities for children to observe that heat causes changes in the state, shape, size, color, volume, or water content of foods. By comparing heated and unheated foods, the changes due to heat are highlighted.

In preparing equal quantities of food at the outset, and in comparing them after the heating, children are introduced to the importance of making careful measurements.

Concepts

From the activities suggested, children learn the following.

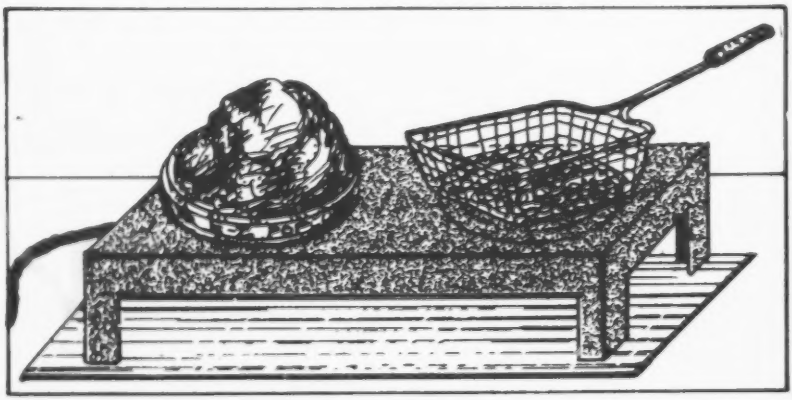
Heat softens some foods and hardens others.

Heat sometimes causes changes in the texture of foods

Heat makes some foods dry out.

Heat sometimes changes the size or shape of foods.

Heat changes the color of some foods.



1. How can we make applesauce?

Arrange an "applesauce party." Give each child a paper plate containing a quarter of an apple (with skin and seeds), a small amount of applesauce, and a spoon. Invite the children to take a small taste of the apple and the applesauce and to compare them. They will comment on taste, color, general appearance and texture. How can we make our own applesauce? List the suggestions given by the children.

On the same or a subsequent day plan to have the children make some applesauce. They help prepare the apples, obtain all the necessary utensils, and stir the sauce (under supervision) as it is cooking. Children observe and comment on the changes that take place as the apples are being cooked. When the applesauce is cooled, all the children taste it.

Another experience which shows how heat changes apples is to bake them. One way of doing this is to wrap an apple in aluminum foil and place it on a hot radiator. Children can compare a baked apple with a fresh apple.

- *We can make applesauce by cooking apples in water.*
- *An apple gets soft and changes color when it is heated.*

2. How can we make popcorn?

Put a layer of popping corn in a wire mesh corn popper. (Save some unpopped corn for comparison later.) Move the popper above a hot plate set at medium heat. As the corn gets hot the children will see and hear the corn pop. (If a corn popper is not available, a "Jiffy Popper" may be substituted.)

While the corn is popping children may say, "The corn is exploding"; "It is popping"; "It makes a big noise." After the popping is done have the children compare the popped with the unpopped corn. They may say, "Look how big it gets." "It turned white." "It feels hot." "It is softer now."

- *Popcorn explodes when it is heated.*
- *Popcorn changes in color, in size, and in the way it feels, when it is heated.*

3. How can we make toast?

Discuss with children what they have had for breakfast. Note that some children eat toast. Ask: "How can we make toast?" Children suggest ways they can toast bread in the classroom. A toaster from home, or a hot plate and a barbecue fork for holding the bread may be used.

The children examine and compare fresh white bread with pieces of toast. They may observe that fresh bread is white, soft, spongy, and becomes doughy when squeezed. On the other hand, well-toasted bread is brown, hard, crunchy, and becomes crumbly when handled.

Additional activities may include having a "toasting party" of various kinds of bread (rye, whole wheat, French or Italian) to note differences.

- *Toast can be made by heating bread.*
- *Heat makes bread dry and crunchy.*

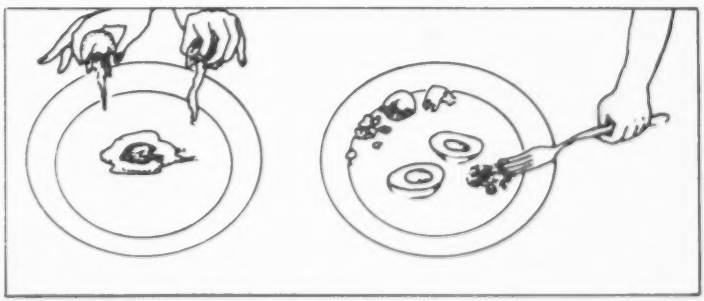
4. How can we make a gelatin desert?

Obtain two packages of gelatin dessert and read the instructions on the box to the children. Prepare the necessary utensils for making the dessert.

The instructions call for the mixing of the gelatin dessert powder with hot water. Ask: "Do you think we can use cold water, instead?" "How can we find out?" Children may suggest mixing the powder of one package in cold water, the other in hot water, and comparing them.

Heat enough water for one package of gelatin powder and pour it into a clear glass bowl. Have ready an equal amount of cold water in another clear glass bowl. Invite two children to add a package of the gelatin powder to each bowl and stir. The other children observe the way in which the powder dissolves in each bowl, and comment on the differences. Both bowls are placed in a refrigerator and compared again.

- *Heat helps to dissolve powdered gelatin.*



Heat makes eggs hard.

5. How does heat change other foods?

From the previous activities children become aware that heat is important in the preparation of foods, and in changing their characteristics.

(Of course the water used is a factor in the changing of foods, but here again it is *heated* water that is involved.)

The following list emphasizes this idea and should serve as a resource for the teacher for providing more experiences for the children. In each case retain an equal quantity of the unheated food for comparison and follow the same steps in preparation except for the heat.

FOOD	CHANGES MADE BY HEATING
Rice	softens, swells
Cranberries	swell, burst, soften
Spaghetti	softens, swells, becomes flexible
Marshmallow	softens, changes in color
Butter	melts
Eggs	harden, change in color

ORAL VOCABULARY

aluminum foil	cranberries	hard	raw
apple	crumbly	heat	radiator
applesauce	crunchy	hotplate	shape
boil	dissolve	marshmallow	size
bread	explode	melt	spongy
butter	feel	mix	toast
color	fresh	popcorn	toaster
cook	gelatin	powder	white

CHILDREN AS DISCOVERERS

Observing In all the problems. Children note the changes which occur as different foods are heated.

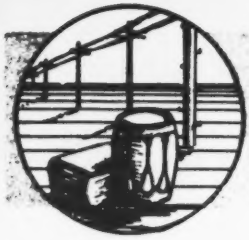
Experimenting Problem 4. Children try mixing gelatin powder with cold water as well as with hot water.

Comparing Problem 2. Children examine the differences between popped and unpopped corn.

Measuring Problem 4. Children measure the amount of water necessary to make a gelatin dessert.

Reporting Problem 5. Children tell about the changes that occur in a variety of foods after heating.

Generalizing Problem 5. Children conclude that heat causes some foods to change in size, color, and texture.



Sounds Around Us

A. CHILDREN LISTEN TO MANY SOUNDS

Background

Children live in a world of sounds. They are entertained, excited, frightened and soothed by different kinds of sounds. They experiment with their own voices to make assorted sounds. They bang the objects with which they play and listen to the sounds produced.

Children learn to relate sounds to the happenings around them: the rumbling of a truck, the foghorn blast of a ship, the jingle of a bell. They recognize sounds in their home, their school, their neighborhood. They relate sounds to men at work: the air drill of the street worker and the whistle of the traffic policemen.

From their own experiences and explorations, children arrive at simple generalizations and some understanding of the science of sound.

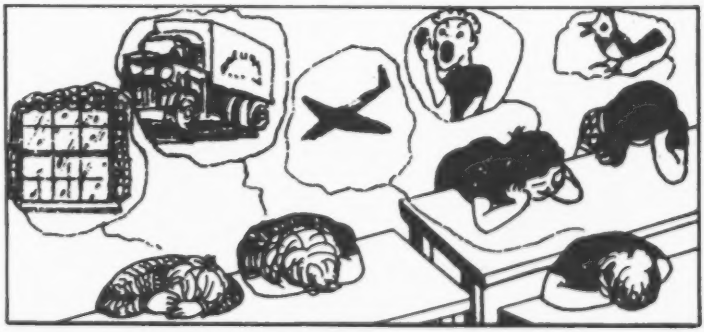
Concepts

From the activities suggested, children learn the following.

There are many different sounds around us.

We can often tell, without looking, what makes a sound.

Different sounds are made in different ways.



1. What sounds do we hear in our classroom?

This is a game in which the children close their eyes and listen to all the sounds they can hear while sitting quietly in the classroom. After a minute or two they name the sounds they heard, such as:

rattling of a window
ringing of a bell
rumbling of a truck
tapping of feet
creaking of floors
hissing of a radiator
flapping of shades
whistle of trains or boats
breathing of a nearby child
screeching of brakes
shouting of voices
singing of birds
honking of auto horns
clanging of garbage cans

- *There are many different sounds around us.*
- *We can often tell, without looking, what made a sound.*

2. What sounds do we hear in our school?

Take the class on a "sound hunt". Ask children to identify the sounds they hear. Confirmation may be made by looking where the sound originates, if practical. List the sounds for follow-up activities in the classroom.

Some of the sounds that may be heard are the following.

On stairs and in hallways:
voices of children and teachers from classrooms
footsteps of people walking up or down stairs
repairmen putting in new windows
ringing of phone or office bell
clinking of china and silverware in lunchroom

Near gymnasium:
bouncing of balls
scuffling of feet
shouts of children

Near auditorium:
sounds from television, phonograph, tape recorder
musical instruments
voices of performers on stage.

On returning to the classroom, discuss the sounds with the children.

- *There are many different sounds heard around the school.*
- *You can often tell what made the sound, even when you cannot see what made it.*

3. What sounds do we hear in our neighborhood?

Take a walk around the block to listen to neighborhood sounds. Ask the children to name the source of each sound, and to imitate it. Some of the sources may be:

barking of dogs
meowing of cats
talking of people
ringing of church bells
honking of automobile horns
screeching of auto brakes
digging of a power shovel
clicking of a traffic light
tinkling of ice cream wagon bell
clattering of air drill
wailing of fire engine sirens

Make a *Neighborhood Sound Book*. Ask the children to paint, draw or cut out appropriate pictures from magazines to illustrate the sound sources in the book. Add to the book as new sounds are heard.

- *There are many different sounds in our neighborhood.*
- *Some sounds are pleasant, some are unpleasant.*

4. What sounds do we hear at home?

After children have had the experience of listening to sounds in the classroom, school and neighborhood, ask them to listen for sounds at home. List the sounds they report under such headings as: *Sounds We Hear In The Kitchen, Sounds We Hear At Night*. Their lists may include the following:

Mother In the Kitchen	Sounds We Hear At Night
running water	hissing of radiators
closing of a refrigerator door	creaking of floors
whirring of an egg beater	rattling of windows
frying of a hamburger	voices
gurgling from a bottle	footsteps
cracking of an egg	flapping of shades

- *There are many different sounds in a house.*
- *Different things make different sounds.*

ORAL VOCABULARY

bark	different	meow	shake
blow	flap	rattle	shout
clatter	gurgle	ring	sing
clink	hammer	roar	wind
creak	hiss	rumble	tap
crumple	honk	screech	tinkle

Observing	Problem 3. Children take a walk around the block to hear neighborhood sounds.
Classifying	Problem 4. Children list sounds heard at home under different categories such as *Sounds We Hear at Night.*
Comparing	Problem 3. Children note differences in sounds: loud and soft; pleasant and unpleasant.
Recording	Problem 3. Children make a *Neighborhood Sound Book* by collecting and pasting picture cutouts of sound sources.
Reporting	Problem 4. Children tell about sounds heard at home.
Generalizing	Problem 1. Children conclude that they often can tell what made the sound even when their eyes are closed.

B. LOUD AND SOFT SOUNDS

Background

As children explore their environment for sounds, they find a wide range of intensity. They strain to hear footsteps in a game of "steal the eraser", or to hear someone humming a lullaby. Other sounds are very loud: jet planes, school bells, and blasts from nearby construction projects.

Children can be helped to increase their own sensitivity to differences in loudness by playing games in which they make or detect loud and soft sounds.

Concepts

From the activities suggested, children learn the following.

Some sounds are louder than others, some sounds are softer.

We can make loud and soft sounds with our voices.

To make louder sounds, we blow, shake, or hit harder.

1. What is the difference between these two sounds?

Play a chord on the piano softly and then play the same chord loud. Ask the children whether they heard any difference. Elicit from them the observation that the first sound was softer and the second sound was louder. Use phonograph for a similar experience. Additional observations may include: teacher's voice, a whistle, or a bouncing ball.

- *Some sounds are louder than others; some sounds are softer.*

2. How can we make our voices louder or softer?

Play the game "Find the Button." Send the child who is "It" out of the room as the class hides a button. "It" returns and hunts for the button. The class furnishes clues by whispering "Cold", saying "Warm", or shouting "Hot."

After the game discuss with the children and have them demonstrate how they changed their voices from soft to loud. Children may say:

"We whispered softly."
"We shouted loud."

Provide additional experiences through games, dramatizing and singing to reinforce recognition of loud and soft sounds.

- *We can make our voices softer by whispering; we can make our voices louder by shouting.*

3. How can we make other loud and soft sounds?

As a result of the previous experiences, children may be able to recognize loud and soft sounds. They have also found out how to make their voices

louder or softer. They may now be ready to explore ways of making other loud and soft sounds.

a. Ask the children how they can make a loud sound with their hands. Some children may clap their hands together. Others may slap the table, pound the chair, or hit their sides. Then ask them to make these sounds softly. Guide them to understand that they can make loud sounds with their hands by clapping and pounding hard. They can make soft sounds by clapping and hitting gently.

   This activity may be repeated by having children tap their feet.

b. Give each child a sheet of paper. Ask how we can make a loud noise with a piece of paper. Lead them to understand that when they shake the paper hard it makes a loud sound and when they shake it gently it makes a soft sound.

   This activity may be followed by other shaking experiences with rhythm instruments, rice in paper bags, marbles in coffee cans.

c. Blow a whistle gently. Ask the class how the sound could be made louder. They will probably suggest that it be blown harder. Have the children make their own paper whistle, using a piece of paper 3" x 6". Help them discover that blowing hard produces a loud whistle; blowing gently produces a soft whistle.

- *We can make loud sounds by hitting things hard; soft sounds by hitting things gently.*
- *We can make loud sounds by shaking things hard; soft sounds by shaking things gently.*
- *To make loud sounds we blow hard; for soft sounds we blow gently.*

ORAL VOCABULARY

clap	pound
gentle	shake
hard	shout
hit	soft
loud	whisper
noise	

CHILDREN AS DISCOVERERS

Observing Problem 1. Children listen for differences between loud and soft sounds.

Improvising	Problem 3. Children devise ways of producing sounds of varying loudness.
Comparing	Problem 2. Children use loud and soft sounds as clues in a game.
Generalizing	Problem 3. Children note that shaking harder produces a louder sound.

C. HIGH SOUNDS AND LOW SOUNDS

Background

In the setting of the previous topic, children learned how to recognize and make sounds of varying loudness. They learned that the terms *loud* and *soft* are used to describe these different sounds.

Another characteristic of sound which children experience is that of *pitch*. By giving them opportunities to hear and make sounds of varying pitch, the teacher can help them develop sharper auditory discrimination. The terms *high* and *low* are used to describe different pitches. Young children sometimes recognize differences in pitch and loudness, but do not have the vocabulary needed to describe these differences.

Concepts

From the activities suggested, children learn the following.

Some sounds are higher than others; some sounds are lower.

We can make our voices sound high or low.

1. What is the difference between these two sounds?

Play a high note on the piano, then play the same note two octaves lower. Ask the children to describe the difference. Elicit from them the observation that the first note was high, the second note was low. Repeat this experience using other pairs of notes. (To ascertain the degree of auditory discrimination, reduce the spread between the two notes).

Follow this activity by using a pair of Melody Bells an octave apart. Ask children to indicate which one sounds higher. Repeat using other pairs of Melody Bells and have them distinguish high sounds from low.

- *Some sounds are higher; some sounds are lower.*

2. How can we change our voices?

Play a game in which children identify each of the bears in "Goldilocks and the Three Bears," by the tone of the question, "Who's been sleeping in my bed?" Ask the children how they were able to "guess" correctly. They might say, "Baby's voice is high;" "Papa bear's voice is low."

Give additional opportunities for dramatization and recognition of high and low voices. Other stories that can be used include: Billy Goats Gruff, Red Riding Hood, Peter and the Wolf, and The Three Pigs.

- *We can make our voices sound high or low.*

ORAL VOCABULARY

different high low Melody Bell piano

CHILDREN AS DISCOVERERS

Observing Problem 1. Children hear the difference between high and low tones.

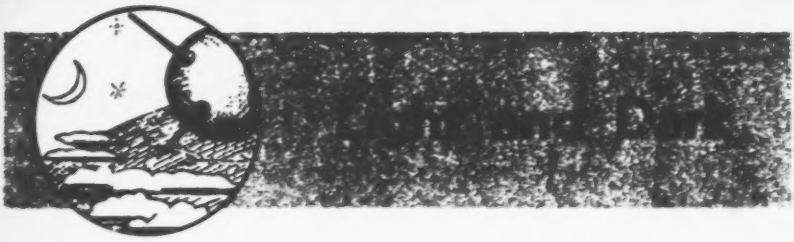
Comparing Problem 2. In dramatizing, children select the pitch suitable for the characterization.

Reporting Problem 1. Children describe the differences they hear.

SELECTED BIBLIOGRAPHY*

The Summer Noisy Book—Margaret Wise Brown
The Indoor Noisy Book—Margaret Wise Brown.
The City Noisy Book—Margaret Wise Brown
All Sizes of Noises—Karla Kushkin
Now I Know—Julius Schwartz

* Complete annotations for these books, and other books related to this topic, will be found on pages 257 to 265.



Background

Children are aware of light and dark (the absence of light). They know that sunset brings dark, night and sleep. Some children may fear darkness. Learning about light and dark may dispel this fear.

Children become aware of the different sources of light. They learn that we can control the amount of light indoors. They engage in shadow play.

Concepts

From the activities suggested, children learn the following.

Light comes from the sun, moon, electric lights, and other sources.

When light is turned off or blocked, it gets darker.

We can make shadows by blocking some of the light with an object.

1. How can we make our room dark?

This topic can be initiated when it is necessary to darken the room for viewing a filmstrip. Children will suggest turning off the lights. Ask them to comment on the differences they observe when the lights are turned out. It may be necessary to turn the lights on again to review the differences.

How can we make the room still darker? Children will suggest pulling the shades. As each shade is pulled, have children comment on the deepening darkness of the room and the difficulty in distinguishing the objects in it.

Sometimes, on a bright sunny day, the room darkens suddenly. What has happened? Children go to the window and see that a cloud is moving "across" the sun. The cloud has made the room darker by blocking off some of the sun's light.

Children should be encouraged to express their feelings and ideas about light and dark. Sometimes the teacher may be able to help them overcome fears they may have about the dark. The following are some typical comments from children.

"I learned that light can help you see and dark can help you not see."
"Dark can be in many places and so can light."

- *We can make our room dark by turning off lights, and by pulling the shades.*
- *Sometimes the room gets darker because a cloud blocks some of the sun's light.*
- *When the room gets darker, it is harder to see the objects in the room.*

2. Where does light come from?

Ask: "What things give us light?" Children may suggest the sun, stars, moon, electric light bulb, filmstrip projector, candle, and flashlight. As far as possible, have these sources available for children to turn on and off, to observe, and to discuss.

When are each of these kinds of light useful? Children may say: the sun makes it light during the day; the moon gives us light at night; electric bulbs light our rooms; a flashlight is useful to help us see things in the dark; the light in a projector throws pictures on a screen.

- *Light comes from the sun, moon, stars, electric light bulbs, and candles.*
- *Different kinds of light help us in different places, at different times.*

3. How can we make shadows in our room?

Ask the children if they can make a shadow on the table with their hands. Each child holds his hand above the table until he sees a dark area. What shape is it? Children observe that the dark area they made on the table is shaped like their hand. Can you make the shadow darker? Children discover that the shadow is darker and clearer when the hand is closer to the table.

Is there another way we can make shadows in our room? Children may recall having wiggled their fingers in the beam of light from a filmstrip projector. Plug in a filmstrip projector and invite children to make shadows on the screen (or wall) with their hands and with toy animals. How did we make the shadow? Children may see that in each case they placed an object between a source of light and a surface (table, screen, wall).

- *We can make a shadow by stopping some of the light.*
- *We can make the shadow darker by moving the object closer to the screen.*

4. What made that shadow?

This can be presented as a game in which the children guess what concealed object is making the shadow. A light beam from a filmstrip projector, or other source of strong light, is directed at a translucent screen, a white, cotton sheet, or a large sheet of paper. The children sit on the opposite side of the screen in a darkened room. The teacher has placed near the projector a box of various objects with which the children are familiar. These may include blocks, dolls, trains, beads and pots. Each child has an opportunity of holding one of the objects in the beam of light, casting shadow on the translucent screen. The other children can see this shadow from the other side of the screen. The children then guess what object is making the shadow, after which it is exposed for their verification and for comparison with its shadow.

A variation on this game is to arrange a shadow parade around some theme such as *The March of the Dolls; Circus In Town; Kitchenware on Parade;* and other themes which may be suggested and developed by the children. Children become aware that the movement of an object causes a corresponding movement of its shadow on the screen. (Wind-up toys emphasize this correspondence.)

- *From the shape of a shadow we can often tell what is making it.*
- *A shadow moves when the object making it moves.*

5. How can we make shadows outdoors?

On a sunny day children may be engaged in such outdoor activities as playing shadow games (Step-On-My-Shadow) and making shadow animals on the side of the building with their hands. This outdoor experience applies and summarizes previous learnings about light, dark, shadows.

- *The sun is a source of light.*
- *We can make a shadow outdoors by blocking some light.*
- *A shadow looks something like the object that makes it.*
- *A shadow moves when the object making it moves.*

ORAL VOCABULARY

block	electric	projector	star
bright	filmstrip	pull	strong
bulb	flashlight	same	sun
candle	hand	shade	switch
chair	light	shadow	table
dark	moon	shape	wall
disappear	move	spot	window

CHILDREN AS DISCOVERERS

Observing — Problem 1. Children note how the darkening of a room makes it difficult to distinguish objects.

Improvising — Problem 4. Children suggest and develop themes for shadow parades.

Comparing — Problem 3. Children notice the differences in shadows made when their hand is held close to the table and when the same hand is held further away.

Generalizing — Problem 4. Children discover that the shape of a shadow is related to the object that makes it.

Applying — Problem 5. Children apply what they know about indoor shadows to make outdoor shadows.

SELECTED BIBLIOGRAPHY*

What's In the Dark?—Carl Memling
The Shadow Book—Beatrice Schenk de Regniers
While Susie Sleeps—Nina Schneider
Now I Know—Julius Schwartz

*Complete annotations for these books, and other books related to this topic, will be found on pages 257 to 265.

Getting Wet and Drying

Background

Playing with water has always been a delight to children. The activities in this unit have been designed to make them aware of the changes that take place in objects when they become wet and when they dry, and to help them discover how they can influence these changes.

Children observe the changes that occur outdoors during and after a rain. They experiment with different kinds of paper to discover which soaks up water best. They expose wet paper towels to different conditions to find out how to dry them more quickly.

Concepts

From the activities suggested, children learn the following.

Rain makes objects wet.

Objects look, feel and smell different when they are wet.

Some kinds of materials soak up water better than others.

When wet things dry, the water goes into the air.

Wet objects can be dried more quickly by warming them.

Wet objects can be dried more quickly by moving air around them.

1. What does rain do to the things on our street?

On a rainy day have the children look out of a classroom window, or from some other vantage point. They comment on the objects that are getting wet: sidewalks, gutters, cars, people, buildings, leaves, soil, grass.

After the rain go for a walk to see how the rain has changed the appearance of the objects. Children comment on the changes they see: soil has become dark and muddy; a car has become shinier and moist; raindrops now hang from the leaves and grass; puddles have formed in various places.

If there is a brief shower followed by the appearance of the sun, children may be able to see the process of drying on sidewalks, cars, gutters.

- *Rain makes objects wet.*
- *Objects look different when they are wet.*
- *When the rain stops, objects begin to dry.*

2. What happens to the objects in our room when they get wet?

During the school year there are many occasions when objects become wet by accident or by design: milk and water spill; paintbrushes, sponges, paper towels, soil in flower pots, and chalkboards are made wet. On these occasions children should be encouraged to comment on the changes that water makes in the appearance and texture of the object.

To focus attention on the changes produced by wetting, the children compare a number of dry objects with similar wet objects; wet and dry sponges, paintbrushes, clay, paper towel, soil, chalkboard. In each case, before wetting an object, ask: What do you think will happen when it gets wet? Retain each dry object for comparison with its matching wet object.

Children notice that brushes become soft, sponges become heavy and large, paper towels become dark and soft, and soil becomes dark and lumpy. They may detect an odor when some things get wet.

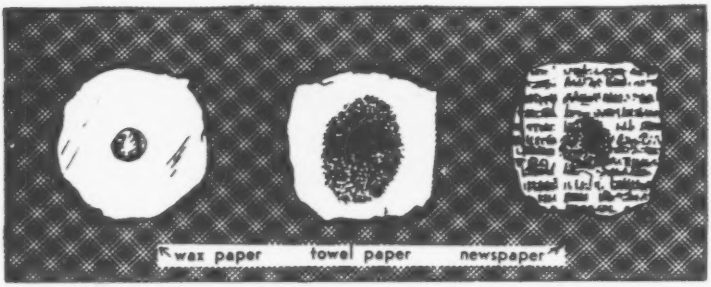
- *When objects get wet they may change in the way they look, feel and smell.*

3. What kind of paper is good for soaking up water?

Distribute at each table a piece of waxed paper, paper towel, and newspaper. Children place a drop of water in the middle of each kind

of paper. They see that water spreads in different ways on different kinds of paper, and is soaked up faster by the paper towel than by newspaper or wax paper.

- *Water spreads in different ways on different kinds of paper.*
- *Some kinds of paper soak up water better than others.*
- *Wax paper does not soak up water.*



Which is best for soaking up water?

4. Where does the water go when you dry your hands with a towel?

Children wet their hands and use a paper towel to dry them. They observe the transfer of water from hands to towel. Have them repeat the experience using a cloth towel. Ask: Where did the water on our hands go? Children can feel that the towel has absorbed the water from their hands.

- *When you dry your wet hands with a towel, the water goes into the towel.*

5. How can you make wet towels dry more quickly?

Dip several towels into a basin of water. Remove them and let the excess water drip off. Ask the children how they would speed the drying of these wet towels. Some children may suggest hanging the towel over a warm radiator; putting it in sunlight; or fanning it. Separate the children into groups to try the various suggestions. One wet towel should be put aside as a control and not be heated or fanned.

Children observe and compare the towels tested under each of these conditions. Include the wet towel that was not warmed or fanned. They

may also wish to try these different methods for drying wet mittens, wet handkerchiefs, or wet doll's clothing.

- *Wet towels can be dried more quickly by warming them.*
- *Wet towels can be dried more quickly by fanning them.*

6. What dries in our room?

Prepare the following materials for examination by children.

Paint jars left uncovered and paint jars closed with lids

Paintings that have dried and paintings that are still wet

Clay left uncovered and clay kept moist in plastic bags

Soil in an unwatered pot and soil in a watered pot

A slice of fruit that has dried out and a freshly sliced piece of the same fruit.

Children compare each pair to observe changes in appearance, touch, color and shape.

- *Most wet things left out in the open will dry.*

ORAL VOCABULARY

air	heavy	shiny
building	large	sidewalk
car	lumpy	sink
clay	moving	soak
cloth	odor	soil
clothesline	open	sponge
dark	paint	sticky
drip	paintbrush	sunny
drop	paper	towel
dry	pot	warm
fanning	quickly	water
gutter	radiator	wet
hand	rain	window

CHILDREN AS DISCOVERERS

Observing	Problem 1. Children observe the effect of rain on various objects.
Experimenting	Problem 3. Children experiment to find out which kind of paper is good for soaking up water.
	Problem 5. Children try different ways of drying a wet paper towel.
Comparing	Problem 3. Children compare different kinds of paper for their "soaking up" qualities.
Generalizing	Problem 6. Children generalize that most wet objects left exposed to the air will become dry.
Applying	Problem 5. Children try out different methods for drying wet things more rapidly.

SELECTED BIBLIOGRAPHY*

Busy Water—Irma S. Black
Now I Know—Julius Schwartz
Rain Drop Splash—Alvin Tresselt

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* Complete annotations for these books, and other books related to this topic, will be found on pages 257 to 265.

A Magnet Holds On

Background

Magnets are traditionally part of the kindergarten equipment. They are educationally interesting because they are self-teaching aids. Children touch various objects with a magnet to discover which it attracts. It is important to allow children to explore freely with magnets.

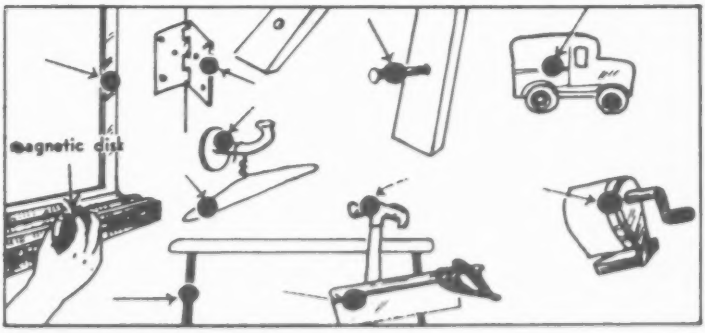
Concepts

From the activities suggested, children learn the following.

A magnet picks up some things but not others.

A magnet picks up and sticks to objects made of iron.

Magnets are used in different ways.



1. What can a magnet do?

Leave a magnet on a table with a box of assorted objects, of which some will be attracted to it and some will not. This assortment should consist of some small objects (clips, fasteners, bottle caps) and some large objects (can, door hinge, scissors, large nail, blocks).

Children play freely with the magnet for many days before the subject

of magnetism is discussed. They may or may not comment on their experiences with the magnet as they engage in their investigations.

After the children have had unhurried, casual experiences with a magnet, the teacher initiates a discussion in which they report their findings.

- *A magnet picks up some things but not others.*
- *A magnet sticks to some things but not others.*

2. What can a magnetic disc do?

Remove the magnet from the box with the objects (see Problem 1) and replace it with a magnetic disc. Again, the children play freely with the magnetic disc and the objects in the box. (A magnetic disc is a magnet set in a plastic container.)

After the children have had a number of experiences with the magnetic disc, ask them to report on what they have discovered about it.

- *A magnetic disc is like a magnet.*
- *A magnetic disc picks up some things and not others.*
- *A magnetic disc sticks to some things and not others.*

3. What does a magnetic disc stick to in our room?

Have available a supply of magnetic discs, preferably one for each child. Ask them to find something in the room to which their disc will stick. Place it on the object and leave it there.

Children might try placing their discs on such things as windows, walls, radiators, steel cabinets, teacher's desk, sink, chairs, chalkboard, doll house, tables, and pegboards. When all the discs have been placed, the children will be able to see at a glance the objects in the room to which they are attached. Ask the children to *name* each of these.

How are all of these objects the same? Children may discover that each one is made of a *metal* (a word that may need introduction).

Does a magnetic disc stick to *all* metal objects? Children may report that it does not stick to the door knob (brass), or to some of the pots (aluminum) in the housekeeping center. The teacher tells the children that the objects to which the disc does stick are made of a certain kind of metal called iron.

- *Magnetic discs stick to many objects in our room.*
- *A magnetic disc sticks only to objects made of metal.*
- *A magnetic disc sticks only to those metal objects that are made of iron.*

4. What makes the magnetic disc work?

By this time children may have noticed that the disc is made of two parts: a small metal bar and a colored disc. Which part of the disc is the magnet? Based on their previous observations, children may suggest that the metal bar is the magnet.

How can we be sure that the metal bar *is* the magnet? If the bar is separated from the disc, children can then test each part to determine which is the magnet. (The magnet bar may be removed by twisting it with a coin to break the glue and then prying it out with a small knife).

- *A magnetic disc is made up of a magnet bar and a colored disc.*
- *It is the magnet bar in the disc that sticks to metal objects made of iron.*

5. What things will stick to a magnetic board?

Stand a magnetic board on end. Ask the children to try to place various things on it. They may use paper, crayons, beads, handkerchiefs, paper clips, and buttons. None of these things will stick to the board.

Have a child place a magnetic disc on the board. The class will observe that it holds on. Repeat with other discs so that a generalization can be formed on the basis of more than one experience. The class will observe that only the magnetic discs stick to the board.

Why does a a magnetic disc stick to the magnetic board? Children may hypothesize that the magnetic board has iron in it (which it does). Will any magnet stick to the board? Children experiment with various magnets and discover that they do.

- *Magnets stick to a magnetic board because it has iron in it.*

6. Are there any magnets in your home?

Children go on a magnet "hunt" at home and get permission to bring in those objects with magnets which can be carried safely. They tell about the magnets in their home and, if possible, show what these magnets do. Included may be magnets which help shut doors, magnets which pick up needles, magnets in pot holders, magnets in can openers, magnets in toys, magnets on bulletin boards, and magnets on pencils.

- *We can find many magnets in our home.*
- *Magnets help us in different ways.*

ORAL VOCABULARY

aluminum	crayon	magnet
bar	disc	metal
bead	door hinge	nail
board	doorknob	paper
bottle cap	fastener	pot
brass	glass	scissors
cabinet	handkerchief	stick
chalkboard	iron	window
clips		

CHILDREN AS DISCOVERERS

Observing Problem 3. Children make note of the various objects around the room to which the magnetic discs stick.

Experimenting Problem 4. Children separate the parts of a magnetic disc and test each part to see which is a magnet.

Classifying Problem 1. Children distinguish those objects that are picked up by a magnet from those which are not.

Generalizing Problem 3. Children conclude that all the objects to which the discs stick are made of metal.

Applying Problem 6. Children find magnets in their homes.

SELECTED BIBLIOGRAPHY*

Mickey's Magnet — Franklyn Branley

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* Complete annotations, and other books related to this topic, will be found on pages 257 to 265.

Water Mixes With Foods

Background

Children have many experiences in which water is used in preparation of foods. The activities in this topic serve to highlight the ways in which various food substances mix with water.

Water is a useful solvent because so many substances dissolve in it. Some familiar substances which dissolve readily in water are sugar, salt and powdered milk. Heating, stirring and shaking hasten the solution.

For many years, fruits, vegetables, and meat have been dried in order to preserve them better. The increasing use of dehydration as an effective method of preserving and packaging foods has led to vast changes in food preparation. Milk, potatoes, eggs, puddings, beverages, and cereals are put up as powders or flakes. Fruit juices and soups are concentrated. The addition of water to any of these items results in a reconstituted food that is similar to the original in appearance and taste. Some kindergarten children may never have become acquainted with foods such as prune plums, grapes or oranges in their natural form, because of the economy and convenience of the dried or canned products.

Concepts

From the activities suggested, children learn the following.

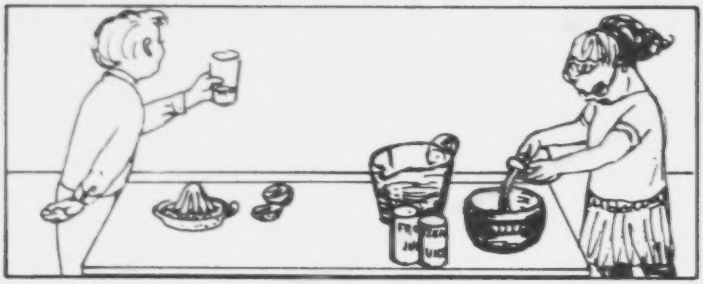
Some foods mix with water.

Some foods color water.

Some foods change the taste of water.

Stirring, heating and shaking help foods dissolve more quickly in water.

We can make dried foods taste and look as they did when they were fresh by adding water to them.



1. How can we make lemonade?

Ask the children to suggest what they would need to make lemonade (water, lemons, sugar). *Note:* The usual recipe for a number of children calls for 2 quarts of water, 4-6 lemons and approximately 6 tablespoonsful of sugar.

Prepare the utensils necessary for making the lemonade: glass pitcher, large spoon, lemon squeezer and enough paper cups for each child. Fill the pitcher half full of water. Ask the children to look at the water. How does it look? How does it taste? Give each child a small sample of water in his cup.

Children assist in squeezing the lemons, and in pouring the lemon juice into the pitcher containing water. What happens when lemon juice is added to the water? Children comment on the mixing of the lemon juice with the water; on the floating of some of the lemon pulp, including some stray seeds; and on the change in appearance of the water.

Pour a small amount of the mixture into each child's cup. How does the mixture (lemonade) taste now? The expressions on the children's faces, and the comments they make are testimony to the "sourness" of the lemonade. What can we do about the sourness? Children suggest adding sugar. They help in measuring and putting it into the pitcher. (Add 3 tablespoonsful of sugar to the lemonade.)

What happens to the sugar? Children observe the sugar particles swirling in the water and settling on the bottom of the pitcher. They stir the mixture and see that the sugar seems to disappear. Where has the sugar gone? Children may suggest that it has gone into the water or that it has mixed with the water. (Both are acceptable). Some children may say the sugar "dissolved" in the water. (Ask them to explain.) How do we know that the sugar is still in the water? Children suggest tasting the lemonade. Pour some lemonade into each child's cup. How does the lemonade taste now? Children will say that it tastes sweeter. Some chil-

dren may feel that it is not sweet enough for their taste. What should we do? Have the children add 3 more tablespoonsful of sugar to the lemonade, and stir. Give each child a taste, and if it is generally approved, distribute the balance of the lemonade.

- *Sugar mixes and disappears (dissolves) in water.*
- *Part of a lemon mixes with water; some floats on top.*
- *Lemon juice makes the water taste sour.*
- *Sugar makes the water taste sweet.*
- *Our lemonade is made of lemon, water, and sugar.*

2. What happens to a lump of sugar in a glass of water?

As a result of making lemonade, children may become interested in what happens to sugar in water.

Give a lump of sugar and a glass or clear plastic cup half-filled with water to each group of two or three children. Have the children observe and report on what happens to the sugar after it is dropped into the water. They may say: "It sank to the bottom," "Look at the bubbles," (air bubbles), "The edges are crumbling," "It is getting smaller".

One question which might follow the children's observations is, "How does the water taste?" Children use straws to taste the water before sugar is added; after sugar is added, but before stirring; and after stirring. Another question which might be raised is, "How can we make the sugar mix (dissolve) more quickly?" Children may suggest other experiments, using measured amounts of water and sugar, which involve stirring, shaking, crushing sugar, and heating the water.

- *Sugar mixes (dissolves) in water.*
- *We can make sugar mix (dissolve) more quickly by stirring or crushing it; by shaking or heating the water.*

3. How can we make orange juice?

Children may suggest making orange juice by squeezing fresh oranges or by using a can of frozen orange juice. (Do not be surprised if you find that many children do not know that orange juice comes from oranges.)

Have the children help in preparing a pitcher of juice from fresh oranges. After they taste the drink, discuss the flavor and consistency.

Now, defrost a can of frozen orange juice and empty its contents into a glass pitcher. Have children observe its thick, syrupy consistency. They may use toothpicks to taste the concentrate, noting its strong flavor.

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What could be done to make it taste more like the fresh orange juice? Some children may suggest adding water. Read to the children the amount of water recommended on the can, and have them help in preparing the juice. Children taste this juice and compare it to the fresh juice, samples of which have been retained for this purpose.

Where does frozen orange juice come from? The teacher may have to help children understand that the frozen concentrate was made from fresh oranges. Why do we have to add water? Again, the teacher may have to help children understand that, in the making of frozen orange juice, water was taken out of it (evaporated). To restore it to the way it was, we put the water back.

- *We can make orange juice by squeezing fresh oranges.*
- *We can make orange juice by adding water to frozen orange concentrate.*

4. How can we make milk to drink from powdered milk?

Show children a glass of milk and a dish of dry powdered milk. Discuss the similarities (color, odor, taste) and differences. An important difference is that one is a liquid and the other is a powder. They may note this difference by feeling, by observing spilled contents (liquid will splash and spread; powder will build up into a mound), and by comparing the types of packaging.

How can we make a glass of liquid milk from the powdered milk? Children may suggest adding water. Read to the children the directions on the box of powdered milk, and use the amount prescribed. They help with the stirring and observe the changes that take place. Pour some into a cup for each child to taste.

Why must we add water to the powdered milk? Children will say, "To make it taste like milk." How does milk come out of the cow, ready to drink or powdered? The teacher may add that in the making of powdered milk, the water is taken out (evaporated).

- *We can make a glass of milk by adding water to powdered milk.*
- *We add water to powdered milk to replace the water that was taken out of it.*

5. What happens to dried fruit in a glass of water?

Show the children a variety of dried fruits (raisins, apricots, pears, prunes and apples). Have them identify the fruits and compare them with pieces of comparable fresh fruits. Children observe differences in size, taste, color, shape, and hardness. Discuss with them the term

Dried fruits change in water.

"dried fruit" and help them to understand that these were once fresh fruits containing water.

How can we make our dried fruits look and taste like fresh fruit? Children may suggest that water be added to the dried fruits. Set up an experiment in which pieces of dried fruit are placed in glass jars or clear bowls of water. Other pieces may be kept in paper plates as "controls". Ask the children to predict what they think will happen. They observe and report changes over a period of several days.

Children may be interested in seeing how a fruit can be dried. Have them place a number of white seedless grapes (separated from the stem) on a sheet of paper towel placed in a dish. They observe for many days how the grapes slowly change into raisins as they dry.

- *When left in water, dried fruits look and taste more like the fresh fruits.*
- *Dried fruits are dry because water was removed (evaporated) from them.*

6. How can we make a sweet drink from a powder?

Children may be familiar with the commercial powders which are used for making cool drinks. Have them help in the preparation of such a drink. Read to them the directions on the package and assemble the necessary materials, including *two* glass pitchers. Drop a small amount of the powder into one glass pitcher containing one-half the measured amount of water, and an equal amount into the other pitcher which has the same amount of water. What happens to the powder? Does it sink? Does it spread out? Does it color the water?

What might happen if the water is stirred? Children check their predictions by stirring the water in one pitcher and leaving the other one. Now stir the "control" and have children continue to add equal amounts

of the remaining powder to each of the pitchers. They observe and comment on the deepening color. They taste, and compare to plain water.

- *The powder for making a drink mixes with water and colors it.*
- *Stirring helps the powder mix (dissolve) in the water more quickly.*

7. How can we make some play-dough?

Have children mix a little water with flour. (Add salt to preserve it.) Children observe that they have formed a sticky dough. A little *dry* flour on their hands will keep the dough from sticking to their fingers.

How can the dough be made more like a paste? Children will suggest adding more water. Use the paste for some of the children's art work.

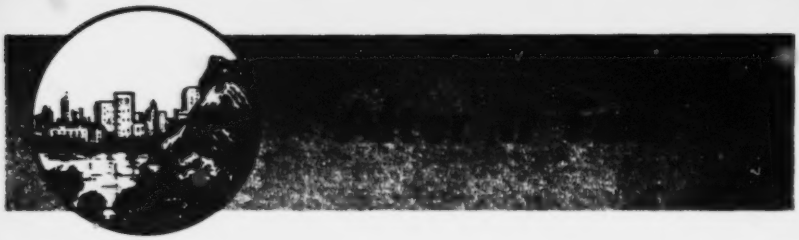
- *Water and flour make a paste.*

ORAL VOCABULARY

apple	flour	paste	sour
apricot	fresh	pear	spill
crumble	grapes	pitcher	spread
crush	neat	plum	squeeze
cup	large	powder	sticky
disappear	lemon	prune	stir
dissolve	lump	raisin	sugar
dough	milk	seeds	syrup
drops	mix	shake	taste
float	orange juice	sink	thick

CHILDREN AS DISCOVERERS

Observing	Problem 2. Children see how a lump of sugar crumples and disappears in a glass of water.
Experimenting	Problem 6. Children determine the effect of stirring on the mixing of a substance with water.
Predicting	Problem 5. Children anticipate what will happen to dried fruits that are placed in water.
Comparing	Problem 4. Children note the difference between powdered milk and whole milk.
Measuring	Problem 6. Children follow instructions to prepare the amounts needed for making a soft drink.
Generalizing	Problem 4. Children find that stirring helps powdered milk dissolve more quickly.



Background

Children are constantly handling a variety of materials, each of which has its own unique characteristics. Some of these are revealed when the materials are "tested" by impact against a hard surface. Children are fascinated by the sounds and sights which result from the dropping of different materials to the floor.

Some materials break when they hit a hard surface; some bounce; some spatter and spread. Some materials such as sand and salt build up into mounds. Children discover that the changes resulting from the fall are more marked if the object is dropped from a greater height.

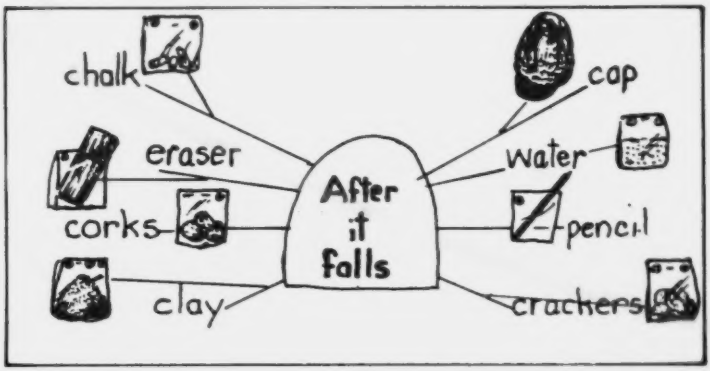
Concepts

From the activities suggested, children will learn the following.

When things fall and hit the floor, they may break, bounce, flatten, spread out, or pile up.

When things fall from a higher place, the changes are greater.

Things that are like each other, such as water and paint, or sand and salt, are affected similarly when they strike the floor.



1. What happens when things fall to the floor?

This activity may be initiated on some dramatic occasion when something falls or spills. Ask the children who observed the accident to tell what they saw, heard or felt. Depending on what happened, they may say, "The paint stained the floor;" "There was a loud bang"; "The cookies broke".

Have children recall various experiences they have had with dropping or spilling things at home or at school. They may mention knocking over milk containers or boxes of cookies, spilling sugar, or dropping a glass, a pot or silverware.

Is there any difference in what happens to different things when they fall on the floor? Ask children to name those things which they would like to see dropped on the floor. Make a list of their suggestions, which might include blocks, chalk, pencils, clay, water, sand, hat, salt, sugar, paper towel, cookies, balls, empty boxes.

Select one object, like a ball, from the list. Have one child drop the ball and ask the others to tell what happened. They will say, "The ball fell," "The ball hit the floor," "The ball bounced," "The ball kept on bouncing," "The ball rolled a little bit after it stopped bouncing." Perhaps the children do not comment on the sounds they heard. Have them close their eyes to *listen* as the ball is dropped again. Let them describe the kinds of sounds they heard.

Children help collect the items listed for future testing. These items may be placed on a table or bulletin board. On subsequent occasions samples of each will be tested and the results of each test may be put into a plastic bag and placed next to the unaltered portion of the original item.

- *Different things happen to different materials when they strike the floor.*

2. What happens when a piece of chalk falls to the floor?

Ask children to predict what will happen when a piece of chalk (full length) falls to the floor. Some children may say that the chalk will break. Have children try it and comment. Into how many pieces did the chalk break? Leave the broken pieces where they fell for later comparison.

How can we drop a piece of chalk (full length) so that it will break into more pieces? Some children may suggest throwing it down very hard. Allow them to try it. How can we make the chalk break into

more pieces without *throwing* it? Children may suggest holding the chalk up very high before dropping it. Allow them to try it. Ask them to compare the number of broken pieces of chalk resulting from this test with the number of broken pieces from the first test.

After a fall, sand builds up into a hill, chalk breaks.

Note: In many of the problems which follow, the same general procedures should be carried out. Following are two helpful techniques.

Drop the materials onto a large area of linoleum, plastic, or paper, to provide the same "landing field" for all.

As a further control, drop objects from the same height, unless height is deliberately varied as in the preceding experiment.

- *When chalk falls, it often breaks into pieces.*
- *When chalk is dropped from a higher place, it usually breaks into more pieces.*

3. What happens when a pencil falls to the floor?

Children drop pencils (with eraser ends) into a receptacle from a specified height. Some children will drop the pencil point first. Some will let the pencil fall flat; others may direct the pencil so that it hits on its rubber end. Children observe that the pencil bounces highest when it lands on its rubber end.

- *When a pencil falls to the floor, it usually bounces.*
- *When a pencil lands on its rubber end, it bounces higher.*

4. What happens to a soft ball of clay when it falls to the floor?

Have children prepare clay balls (2" diameter or larger). Test for roundness by rolling. Drop one of the balls. Children examine it and compare it with an undropped ball. They discover that the part that hit the floor is flattened, while the rest remains round.

Drop the same ball a number of times. Children examine it to note changes. They see and feel that it now has a number of flat surfaces.

What will happen if we drop a soft ball of clay from a high place? Children predict what they think will happen. One child drops a ball of clay from waist height; and another ball from as high as he can stretch his arm. Which ball of clay is flattened more?

- *When a soft ball of clay falls, the side that hits is flattened.*
- *When a soft ball of clay falls from a higher point, it flattens more.*

5. What happens when water spills and falls to the floor?

While many children have had a number of experiences with water, most have not taken the time for close observation of what actually happens when spilled water falls to the floor.

Have children pour a small amount of water from a specified height into a tin or basin. Encourage them to make careful observations and comment on what they see. They may say "It splashes onto the floor," "It splashes," "It spreads out," "The pool of water shakes."

- *When water falls to the floor, it spreads out.*
- *Water splashes when it falls to the floor.*

6. What happens when sand is poured and falls to the floor?

Have children pour sand slowly from their hands or from cups into a cookie tray. They note that this material behaves differently from those previously used. Children comment on their observations. They may say, "We can make hills," "It sounds like rain."

- *When sand falls on the floor, it often builds up into a small hill.*

7. What happens when different things fall?

From this activity have available various materials, including samples of those which children have already tested, as well as some which they have not. The previously tested materials may include those which will break, bounce, flatten, spread, and build up. The new materials may include crackers, white library paste, tempera paint, salt and sugar.

Display all the materials on a table. Ask the children to predict what will happen when each is dropped. Then experiment with each.

Children observe that certain materials, such as milk, water and tempera paint, are affected similarly. They also recognize that some materials such as salt and a rubber ball, are affected differently.

- *When things fall to the floor, they break, bounce, flatten, spread out, or build up.*
- *Things that are like each other, such as water and paint, or sand and salt, are affected similarly when they strike the floor.*
- *Things that are not like each other, such as water and a pencil, are affected differently when they strike the floor.*

ORAL VOCABULARY

basin	eraser	patter	spill
bounce	fall	pencil	splash
break	flatten	pour	spatter
build	height	round	spread
chalk	high	salt	stretch
clay	material	same	throw
different	paint	sand	tray
drop	paper	shape	waist

CHILDREN AS DISCOVERERS

Observing Problem 1. Children describe what they see and hear when a ball is dropped.

Experimenting Problem 3. Children test the effect of height on the flattening of a ball of clay.

Predicting Problem 2. Children guess what will happen to a piece of chalk when it falls to the floor.

Comparing Problem 3. Children examine a dropped and undropped ball of soft clay.

Problem 1. Children compare the number of broken pieces of chalk when dropped at different heights.

Recording All the problems. Children arrange the dropped objects on the bulletin board or table.

Reporting Problem 1. Children relate personal experiences with accidental dropping of objects.

Generalizing Problem 7. Children become aware that similar things happen to like materials when they strike the floor.

Seesaws and Balances

Background

When children play with their partners on a seesaw, they often unwittingly become involved in problems of balance. When they reconstruct their outdoor seesaw with planks and blocks, they become more aware of the principles involved.

Both the indoor and outdoor experiences developed in this topic help children to learn the meaning of balance and how unequal weights on a seesaw (scale) may be balanced. Moreover, the use of blocks to balance toys and other objects introduces children to the idea of a unit of measurement.

Concepts

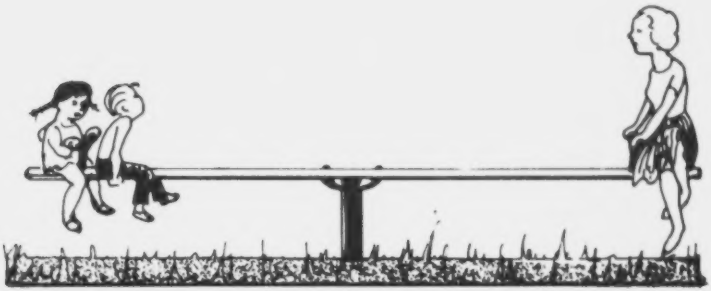
From the activities suggested, children learn the following.

Children have different weights; some are lighter than others.

Children of the same weight can balance each other easily on a seesaw.

A light child can balance a heavy one if the big one moves closer to the center of the seesaw.

A seesaw (balance) can be used to find out which of two objects is heavier.



1. How can you balance your seesaw partner?

The problem of balancing a seesaw partner is one that comes up naturally in a playground. Visit a nearby park or playground which has seesaws. Ask the children to choose a seesaw partner. After the children have been given time for free play on the seesaws, have them all gather around *one* seesaw. Ask for two volunteers to sit in the same position at the ends of the seesaw. Have the other children comment on what they see happening. They may say that the seesaw is "even" or that it is "tipped". It may be helpful if the children are guided to say, "The seesaw is level," or "The seesaw is not level." If the seesaw is not level, ask: "Which child is up? Which child is down?" Give each pair of children a chance to sit on the seesaw, making sure that each one is in the same position at his end. During this time the other children will judge whether the seesaw is level or not, and which child is up and which is down. Children will conclude that they may or may not "balance" (if necessary, introduce this word) their partner.

Select a pair who were not balanced. Ask the other children to name a replacement for one of the chosen pair. As children are selected, each one sits in the same position at the opposite end of the seesaw. The class evaluates each of its own selections.

- *Some partners balance each other on a seesaw.*
- *Some partners make the seesaw tip.*

2. How can you balance your seesaw partner if he is heavier (or lighter) than you?

At the park or playground, raise the above question and allow children to work out the answer on the seesaw. It is interesting to note that children naturally try to attain balance by shifting their weight, by placing their hands on the seesaw to lean forward or backward, or by moving to a new position on the seesaw.

Have children observe how each pair of unbalanced partners attempt to balance the seesaw. They comment on what they see happening. Some may say, "One child moved in," "One child leaned backward."

- *A light child can balance a heavy child on a seesaw if the heavy one moves toward the center.*

3. Can a grown-up be your seesaw partner?

On a subsequent visit to the park or playground, show the class that a child can balance his teacher on a seesaw, although the latter is heavier. (The teacher moves in close to the center of the seesaw).

Ask the children how you (the teacher) could sit near the end of the seesaw and still be balanced. Their suggestions may include some of the following.

"Another grownup can balance you."

"Two or three children can balance you (the teacher)."

Try out these and other suggestions that the children may offer.

- *A grownup can be a child's seesaw partner if the grownup sits close to the center.*
- *Two or three children can balance a grownup on a seesaw.*

4. How can you make a seesaw with blocks?

Children set up an indoor seesaw by placing one long block (plank) on top of a cylindrical block that is held in place with two wedge blocks. They adjust the seesaw by moving the plank until it is balanced.

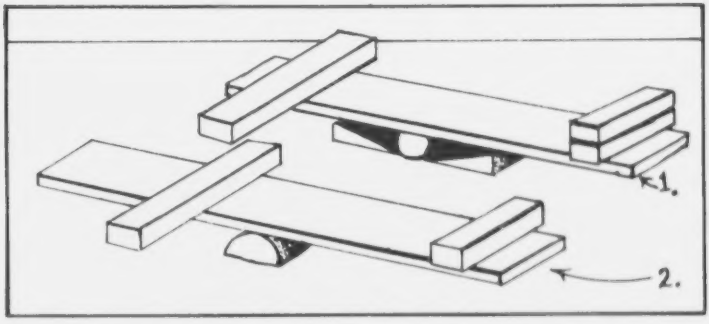
Children test their seesaw with toys, dolls, and blocks to see if, like an outdoor seesaw, it will balance or tilt up and down.

- *We can make a seesaw with blocks.*

5. How can you balance blocks on a seesaw?

The activities with block building that are suggested here duplicate in principle the outdoor experiences of Problems 2 and 3 in which children balanced themselves.

Show children a collection of blocks of varying sizes. Ask them to select two that they think would balance if placed on the seesaw made



1. **Two small blocks can balance a large block.**
2. **One small block can balance a large block if the large one is closer to the center.**

in the preceding problem. They may suggest two blocks of equal size placed near either end of the plank. Some children may try blocks of unequal sizes, placing the larger block closer to the center at its end of the plank.

Ask the children how they could balance a large block placed near the *end* of the plank, *without* using another similar block. They may try using two or more smaller blocks to balance the large one.

- *Two blocks of the same size, placed at each end of a plank, can balance each other.*
- *A light block can balance a heavy block, if the heavy one is closer to the center.*
- *Two or more light blocks at one end of a plank can balance one heavy block at the other end.*

6. Can you balance toys with blocks?

The purpose of this activity is to introduce the idea of a unit of weight. In this case the unit is a block.

Arrange the block seesaw as in Problem 4. Place a toy such as a truck, fire wagon, or boat at one end of the seesaw. Ask the children to find a block, or combination of blocks, to balance the toy. Repeat this activity using other toys in the classroom.

- *Blocks can balance toys.*

7. How can you tell which toy is heavier?

Place a number of toys on a table for the children to examine. Which toys seem heavy? Which toys seem light? Children may lift each and compare the relative weight. This will probably lead to many disagreements. How can we be sure? How can a seesaw (scale) help us to be sure?

Balance the block seesaw (scale) with nothing on it. Have some children place the toys, one at a time, on one end of the seesaw. Use blocks of the same size, and place them at a standard distance from the center, one block at a time until balance is achieved. As a way of recording their findings, children may match each toy with the number of blocks that it balanced. They may say "The toy wagon is heavier. It weighs the same as four blocks." "The toy truck is lighter. It only weighs as much as two blocks."

- *A seesaw and blocks can be used to find out which of two objects is heavier.*

ORAL VOCABULARY

away from	even	same
backward	forward	scale
balance	grownup	seesaw
big	heavy	small
center	identical	tip
close to	level	toy
different	light	up
down	partner	wedge
end	plank	weight

CHILDREN AS DISCOVERERS

Observing	Problem 1. Children describe the position of the seesaw as "tipped" or "level."
Experimenting	Problem 2. Children try out different positions on a seesaw to make it balance.
Predicting	Problem 1. Children select a child whom they think will balance another one on a seesaw.
Comparing	Problem 7. Children judge the relative weight of toys
Measuring	Problem 5. Children find that two or more small blocks can balance one large block.
	Problem 7. Children begin to use a block as a unit of measurement.
Recording	Problem 7. Children match each toy with the number of blocks that it balances.
Generalizing	Problems 2, 3 and 5. Children decide that a small weight can balance a large weight if the large weight is moved closer to the center of the seesaw.

SELECTED BIBLIOGRAPHY*

Ups and Downs—Ethel S. Berkley

Let's Find Out What's Light and What's Heavy—Martha and Charles Shapp

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* Complete annotations for these books, and other books related to this topic, will be found on pages 257 to 265.

Background

Bubbles

Bubbles, bubbles
In the air,
Bubbles, bubbles
Everywhere!

Some are big,
And some are small,
But they are ———
Bubbles all!

Class K-1-2, 24 Bronx, N.Y.C.

Blowing soap bubbles is a delightful sensory experience for children. It is also a time when children can become more observant of size and shape, and of reflections and colors. Even the breaking of a soap bubble helps children learn that it is made of a tiny drop of soapy water and air.

Concepts

From the activities suggested children learn the following.

We can make bubbles by blowing air into soapy water.

Some bubbles are big; some bubbles are small.

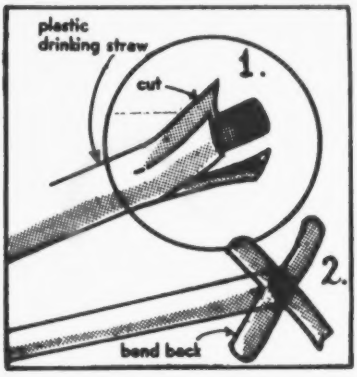
Bubbles can have different shapes.

Wind makes bubbles move.

A soap bubble is made of soapy water and air.

1. How can we make soap bubbles?

Children should be given the opportunity to play freely and at length with a soap-water mixture before focusing their attention on the specific characteristics of soap bubbles. A generous spread of newspaper on the children's table is advisable for this and subsequent activities.



An ordinary drinking straw, not the very thin kind, may be made into a bubble pipe by cutting one end of the straw and spreading out the tabs. Such straws (or cones made of oaktag) may also be dipped into the soap bubble mixture and used as wands for casting bubbles into the air.

Ask the children to try to make bubbles with plain water in a glass or jar. They will observe that bubbles form under water but break when they reach the top. They may then use soapy water to blow bubbles.

Have ready some liquid detergent (used for dishwashing), water, glycerine, sugar, jars or paper cups, drinking straws (preferably of plastic) and an egg beater. To make the soap bubble mixture, combine 1 part liquid detergent with 1 part glycerine and 5 parts clean water. A pinch of sugar may be added to toughen the bubble. Mix the ingredients with the help of the egg beater and pour the mixture into individual jars or cups.

How do we make bubbles? Children may say, "We blow," or, "We blow into the water." What is inside a bubble? (Air.) What is on the outside of a bubble? (Soapy water.)

Children may also use commercial bubble pipes or wands, and commercially prepared bubble mixtures.

- *When we blow into plain water, the bubbles break.*
- *With a soap and water mixture we can make bubbles that last.*
- *Bubbles are made of soapy water and air.*

2. How big are the bubbles?

After children have had some experience with blowing bubbles, they may be more interested in looking carefully at their product.

Children dip their straws, pipes or wands into soapy water. They blow or cast bubbles, first gently and then with more force. They observe the different sizes of the bubbles. As they are produced they describe bubble sizes by comparing them to familiar objects such as grapes, plums, oranges and grapefruits.

- *Some bubbles are bigger than others; some bubbles are smaller.*

3. What is the shape of your bubble?

Children observe the shapes of bubbles as they are being formed. They may do this more easily by observing another bubble-blower at work, and commenting on what they see. Some children may say, "It looks like a pear," "It looks like a football," "It looks like a small watermelon."

When the bubble is free, ask, "What shape is the bubble now?" Children may say, "It is round like a ball," "It looks like a balloon."

Children may also see bubbles sticking together, and note the flattened surfaces which form between adjacent bubbles. They may say, "The bubbles have square ends where they touch," "The bubbles are flat where they touch."

- *When a bubble is free, it is round.*
- *While a bubble is being made, it sometimes is long.*
- *When two bubbles are together, the part that touches is flat.*

4. What can you see in a soap bubble?

Children blow bubbles using straws, pipes or wands. What can you see in your bubble? Some children may say that they see colors; others may say that they see reflections of windows, electric lights, and other objects in the room.

Can you see through your bubble? Children blow bubbles and while the bubble is attached to the pipe, place one hand or an object on the other side of the bubble. They comment on what they see.

- *We can see colors in our bubbles.*
- *We can see reflections in our bubbles.*
- *We can see through our bubbles.*

5. How can you catch a soap bubble?

Children blow bubbles and try to catch them with their hands. They then try catching bubbles on a piece of cardboard, on a book, on a dish, and on other objects. They observe that their bubbles generally break quickly. However, they note that when bubbles land on soapy surfaces they remain intact for some time.

What is a good way to catch bubbles? Children may suggest using a soapy wand, a soapy bubble pipe, a soapy straw or soapy water in their hands or in a dish. They try out their suggestions and report on the results obtained. In the process of reporting, children will note that *all* of the methods which succeeded require a soapy water surface for catching bubbles.

- *We can catch bubbles with things that have soapy water on them.*

Bubbles come in different shapes and sizes.

6. How can you make your soap bubble move?

Children toss bubbles off their bubble makers and watch how they move. Some may move up and down, and some may move sideways.

What can we do to make our bubbles move? Children may suggest using a sheet of cardboard to fan the bubbles. They try this out and comment on how the bubbles fly off. In what direction do they go?

On a subsequent day, outdoors, children blow bubbles and watch how they fly with the wind.

- *We can make bubbles move by tossing them, by blowing on them, and by letting the wind blow them.*

7. What happens to a soap bubble when it breaks?

Have children blow a bubble, release it, and observe it carefully until it breaks. What is a bubble made of? Children will say that it is made of soapy water. Is there anything else in the bubble? Some children may say that they blow air into the bubbles.

What happens to the bubble when it breaks? This time have the children catch a bubble on a large green desk blotter. What can you see? Children observe the tiny speck of water left on the blotter. They compare the size of this speck of water with the size of the bubble. What makes up the rest of the bubble? Children conclude it must be the air that they blow into the bubble. What happens to the air when the bubble breaks? Children may say that the air goes out when the bubble breaks.

- *A bubble is made up of a tiny drop of soapy water and a lot of air.*
- *When a bubble breaks, some of the water in it makes a tiny wet spot.*
- *When a bubble breaks, the air in it escapes.*

ORAL VOCABULARY

air	gently	reflection
big	grape	round
blotter	grapefruit	see
blow	green	small
break	light	soap
bubble	liquid	straw
catch	many	tiny
color	move	top
count	object	touch
detergent	orange	wand
dish	pipe	water
flat	plum	window
float	powder	

Observing	Problem 3. Children describe the shape of bubbles.
Improvising	Problem 4. Children suggest ways of catching bubbles.
Experimenting	Problem 1. Children use plain and soapy water to see which is best for making bubbles.
Comparing	Problems 2 and 3. Children compare the sizes and shapes of bubbles with familiar objects.
Generalizing	Problem 7. Children conclude that bubbles are made of soapy water and air.

Grade One

Weather From Day to Day

A. A SUNNY DAY

Background for the Teacher

Radiant energy comes to us from the sun. Three components of the sun's radiation are of particular importance for life on earth: infrared rays, ultraviolet rays (both invisible) and the rays which constitute visible light. Infrared rays are those which warm the earth. Ultraviolet rays stimulate the production of Vitamin D in organisms and are responsible for suntanning. Visible light rays illuminate the earth, and are essential for food-making by green plants.

Since the earth is 93 million miles away from the sun, it receives only one 2-billionth of the total radiation; the rest goes into space.

The earth's atmosphere is not heated appreciably by the sun because air is a poor absorber of radiation. That is one reason why it gets colder as one rises into the air, even though one moves closer to the sun. The earth itself, however, is a good absorber of radiation and so it is warmed by the sun. The warm earth, in turn, heats the air close to it.

The sun heats any particular part of the earth more at noon, when it is high in the sky and shines most directly on that part of the earth. The sun heats the earth less when it is low in the sky, as in the early morning and late afternoon.

Approaches and Concepts for the Child

Sunlight is readily available for science experiences and experiments. Children observe the sun and its effects at home, on their way to and from school, and in the classroom.

From the activities suggested, children learn the following.

The sun heats and lights the earth.

The sun helps to dry wet objects.

Shade is formed where sunlight is blocked.

The thermometer shows the temperature of the air around us.

1. How do things feel in sunlight?

Ask children to feel various things outdoors in sunlight: automobiles, concrete sidewalks, the walls of buildings, metal gates, fences, lamp posts, their own clothing. Compare the temperature of the various objects in sunlight. Each child's hands will act as his own "thermometer."

- *The sun heats all things.**
- *Some things get hotter than others.*

2. Why do we look for a shady place on a hot, sunny day?

Have children stand under a shade tree after having been in direct sunlight. Ask if they feel any difference. What other shady areas can be found in the neighborhood? Ask the children to feel the sidewalk in the shade and compare it with the part in the sun.

- *Shade is made by things coming between us and the sun.*
- *On a hot, sunny day we feel cooler in the shade.*

3. How do we keep the sunlight from coming into our room?

Draw only some of the shades in the classroom on a hot, sunny day.

*Statements set in italics and following bullets are understandings which may result from the activities.

Have children sit in the sunny area and then move to the shaded area. Feel the top of a table in the sun and one in the shade. What differences are found? Why are shades called "shades"?

- *We feel cooler in the shade than in sunshine.*
- *Window shades help keep us cool by stopping some of the sunlight.*

4. What happens when a cloud hides the sun?

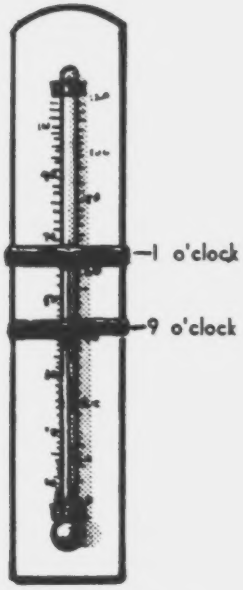
Children discuss what happens when clouds appear on a sunny day. What happens when a cloud gets between them and the sun? What happens when the cloud moves away?

- *When a cloud moves between the sun and the earth, some of the sun's light does not reach us.*
- *Clouds are closer to us than the sun is.*
- *We know that the clouds are closer because they sometimes hide the sun.*

5. Why do people hang wet clothing outdoors on a sunny day?

Wet two cloths of the same size and material. Wring both out. Hang one in sunlight and one in the shade. After enough time has elapsed for the cloth in the sun to dry, have children feel both cloths and report their findings.

- *Sunlight helps dry things.*



6. What happens to an outdoor thermometer when the day is very warm?

Show the children a thermometer. Hang or place the thermometer outdoors in the shade at about 9 o'clock in the morning. (*Note:* Thermometer readings should always be taken in the shade.)

Call attention to the top of the liquid in the tube. Mark this level with ink, tape, rubber band. Every hour, note with the children whether there is any change in the level of the liquid in the thermometer tube.

Place the thermometer in a pan or glass of cool water so the children may observe a decrease in the length of the column of liquid.

- *A thermometer shows us the temperature of the air.*
- *When the day is warmer, the colored line in the tube of the thermometer is longer.*
- *When the day is cooler, the colored line in the tube of the thermometer is shorter.*

7. How can we "keep cool" on a hot day?

Ask the children for suggestions. These may include the use of fans, air conditioning, moving into the shade, adjusting room ventilation to

permit circulation of the air, washing in cold water, not being too active, wearing lightweight clothing. If possible, have the class try some of these methods.

- *There are many ways of keeping cool in hot weather.*

EVALUATIVE ACTIVITIES

1. Does the sun warm soil? How could you find out? (Use your hand or a thermometer to compare the temperature of soil in sun and similar soil in shade.)
2. Does the sun warm the water in an aquarium? How could you find out? (Note temperature of water in aquarium in sun and similar one in shade.) Note: If there are fish in the aquarium, do not permit the water to become too warm. This activity may call to the attention of children the need to protect fish from overheating by sunlight.
3. How do you know that clouds are closer to us than the sun? (The clouds can hide the sun from us.)
4. How do you know that a bird is closer to us than most clouds? (We can see the bird in front of the clouds.)
5. Draw three thermometers on the chalkboard, as shown.* Which thermometer shows the coolest day? (C) Which thermometer shows the warmest day? (B) What will happen to this thermometer (C) when

it is brought into a very hot room? (The line will get longer.) What will happen to this thermometer (B) when it is placed in a glass of ice water? (The line will get shorter.)

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*The letters "A", "B", and "C" are not to be used in your drawing or discussion. The child or teacher will point to the appropriate drawing.

B. A WINDY DAY

Background for the Teacher

Wind is air in motion, motion caused basically by unequal heating by the sun of different kinds of surfaces of the earth. Oceans, plains, forests and mountains absorb the sun's rays differently. Latitude and altitude also affect the extent to which these surfaces are heated.

The air over the warmer areas expands and becomes lighter. Cold air, which is heavier than warm air, pushes in under the lighter air and forces it upward. Since the earth is hottest at the equator and coolest at the poles, a global wind circulation is set up, with cold air moving from both north and south hemispheres toward the equator and warm air moving toward the poles. The earth's revolution from west to east, and many other factors, also influence the global and the local winds.

Approaches and Concepts for the Child

Children have felt the wind push them, and they, in turn, have pushed against the wind. They have seen the wind blow papers in the street, and overturn street litter baskets. They have heard it whistle and howl.

From the activities suggested, children learn the following.

Wind is moving air.
Wind pushes and carries things.
Wind can do damage.
Wind makes waves.
Wind helps dry things.

1. What is the wind doing?

Take the children outdoors on a fairly windy day, or have them make observations from the classroom window. Observe hanging signs, loose paper, leaves and branches of trees, flags, smoke, posture of people walking with or against the wind. What is the wind doing to each?

If possible, obtain milkweed seeds, or any other seeds that are carried by wind, and have children launch these into the wind. How far, how fast, how high do the seeds travel? What does this tell us about the wind?

- *The wind can make things move.*
- *The wind can blow in different directions at different times.*

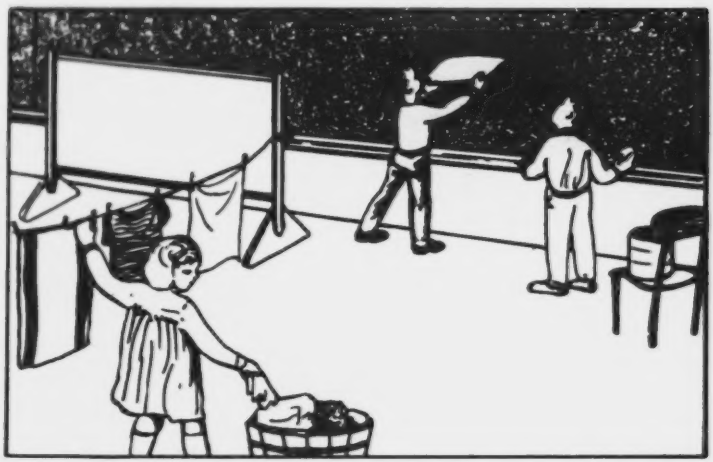
2. How can we tell which way the wind is blowing?

Take a walk on a windy day. Observe the movements of smoke, clothes hanging on a line, flags, trees or grass. Attach a nylon stocking or a piece of tissue paper to a stick and hold it in the wind. Ask the children to point to the way the wind is blowing.

- *We can tell which way the wind is blowing by seeing which way things in the wind are moving.*

3. What does the wind do to wet clothes on a line?

Ask the children to relate their experiences in drying wet clothing. Ask them how they might experiment to find out whether the wind helps in



drying things. They may suggest wetting two pieces of cloth, of same size and material, and placing one in the wind, and one in a place protected from the wind. The air temperature and the amount of sunlight received should be the same in both places.

To simulate the effect of the wind indoors, wet two pieces of quick-drying cloth (pieces of old nylon stockings are good) of the same size and material, wring them out thoroughly, and hang them on a line. Fan one vigorously with a piece of cardboard. Make sure that the breeze does not reach the other cloth. Note which one dries faster. This effect may also be produced by placing on the blackboard two wet spots of the same size, a good distance apart, and having a child fan only one.

- *The wind helps to dry wet clothes.*

4. What does the wind do to sailboats?

The children play with a toy sailboat in a basin of water. Ask the children to suggest ways of making their own indoor wind. "Wind-makers" may include their mouths, balloons, drinking straws, flat cardboard. Have them try the "wind-makers" on the boat. Watch the boat move. What is moving the boat? What happens if the "wind" is too strong? Conduct a race between two boats.

- *Wind moves a sailboat.*
- *When the wind blows hard, a sailboat may tip over.*
- *We can make a "wind" in different ways.*

5. What does the wind do to water in puddles, ponds, lakes and oceans?

If it is windy after a heavy rain, take the children outdoors to observe the effect of wind on the surface of water in a puddle or nearby pond.

To simulate this effect of wind in class, have children blow on the surface of water in a pan. Observe the ripples or little waves. Give each

child a drinking straw to blow through. Is there an increase in the size of the waves? When they fan the water do the waves get larger?

- *The wind makes waves by pushing on the water.*
- *Strong winds make large waves.*

6. How strong is the wind today?

On a windy day, have children relate their experiences with the wind. While coming to school, some have walked *with* the wind, others *against* it. Encourage them to dramatize their experiences. Collect and discuss pictures which demonstrate damage caused by wind, such as trees blown down, umbrellas broken and store windows smashed.

Observe an outdoor flag daily for a period of a week and keep a pictorial record of its appearance.

Construct crepe-paper streamers, pinwheels, milk-carton windmills and other toys moved by wind. Observe and compare their motion during several windy days.

- *Sometimes the wind is just strong enough to be felt.*
- *Sometimes the wind is strong enough to do damage.*
- *We can see how strong the wind is by watching smoke, umbrellas, trees, and signs.*
- *We can see how strong the wind is from day to day by watching it blow a flag.*
- *We can see how strong the wind is by watching it turn wind toys.*

7. What is wind?

Take children outdoors on a fairly windy day. What is the wind doing? What kinds of sounds does it make? Let them express, in words and in gestures, their reactions to the wind.

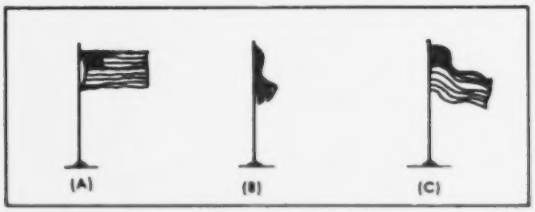
In class, have the children open the cover of a book and close it quickly. They will feel a wind on their faces. Blow up a balloon. Release the air from it near some scraps of paper. Show children how to make fans to wave near their faces. Children discover that when air is moved it feels like wind.

- *Wind is moving air.*
- *Wind moves things.*
- *Sometimes wind makes sounds.*

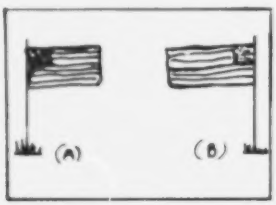
EVALUATIVE ACTIVITIES

1. How can you tell whether it is windy without opening the window or going outside? (Look at flags, papers, kites, smoke, to see if and how the wind is blowing them.

   Draw three flags, as shown. Which flag shows the windiest day? (A) Which flag shows the least windy day? (B) *



3. Draw two flags, as shown. Point the way the wind is blowing this flag (A). (To the right.) This flag (B). (To the left.)



4. Who likes windy days? Why? (Sailboat owners; mothers who hang wet clothes to dry; children who fly kites.)

5. Who does not like windy days? Why? (Walkers who get cinders in their eyes; outdoor fruit and vegetable men, because of the dust; people in small motorboats, because of the waves; old people who have trouble walking.)

6. How can you make a wind inside a room? (Open a window; fan the air; turn on an electric fan; blow; let air out of a balloon.)

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*The letters "A," and "B" are not to be used in your drawing or discussion. The child or teacher will point to the appropriate drawing.

C. CLOUDY AND FOGGY DAYS

Background for the Teacher

When water evaporates, its individual molecules move into the air and disappear. Water in this invisible form is called water vapor. As air containing invisible water vapor rises in the atmosphere, it is cooled. As a result the water vapor condenses into droplets. These droplets usually form around very small particles of dust, pollen, smoke, ash, or salt. Clouds consist of millions of these droplets of water. The droplets are kept up in the air by rising currents which lift them faster than they can fall. It takes almost a million droplets to make one raindrop.

Sometimes air near the surface of the earth is cooled and the water vapor in it condenses, forming a cloud on or near the ground (a fog).

Approaches and Concepts for the Child

Children's imaginative responses to the varied forms and movements of clouds, and to the mistiness of fog, serve as a motivation for this topic.

From the activities suggested, children learn the following.

Clouds differ in color and shape.
Some clouds are very high in the sky, some are much lower.
Clouds are moved by wind.
A cloud is made of tiny drops of water or crystals of ice.
It is difficult to see in a fog.
Fog makes things feel moist.
Fog is a cloud near the ground.

1. Are there any clouds in the sky today?

Take children outdoors on a day when there are scattered clouds present. Let the children note the cloud forms. They may associate the shapes with things known to them. Let them note any movement among the clouds. Try to get observations (within their capabilities) of the relative height of clouds. Do they seem higher or lower than the sun? (Children should not look at the sun *directly*.) Are they higher or lower than other objects viewed against the sky: a bird or an airplane? Are the clouds dark or light? How much of the sky is covered with clouds? Do they show any colors?

- *Clouds have different shapes.*
- *Some clouds are high in the sky; some are low.*
- *Clouds move.*

2. What may happen when clouds get very dark?

Observe the sky on a threatening day, particularly when a thunderstorm is gathering. Encourage children to observe the changes in clouds and to predict what may happen to the weather.

- *When clouds gather and darken the sky, rain may fall from them.*

3. Have you ever been in a cloud?

Ask the above question on a foggy morning. Some children may recall having flown through a cloud in an airplane. But all will be surprised

and delighted to learn that the fog they walked through on the way to school was a cloud on the ground.

- *Fog is a cloud on the ground.*

4. How do things look and feel on a foggy day?

Have children observe and tell how things appear outdoors on a foggy day. How clearly, and how far away, can one see people, cars, buildings and trees? Have them touch many things on a foggy day, such as the walls of buildings, autos, glass, metal, cement. Do they feel moist?

Watch the flow of traffic. Are cars going as fast as usual? Are the people walking as rapidly as they usually do?

- *When it is foggy, it is hard to see things around us.*
- *Fog makes things feel moist.*
- *We cannot see very far on a foggy day.*
- *Traffic must move more slowly on a foggy day.*

EVALUATIVE ACTIVITIES

1. How can you tell by looking at the sky that it may rain? (Sky is dark; sky is cloudy.)
2. Do you always have a shadow in the daytime? (No.) Why? (The sun is hidden by clouds; you are standing in the shade of a building.)
3. Which way are the clouds moving? (Children point.) What makes clouds move? (Wind.)
4. Are all clouds moving in the same direction? (Not always.) Why? (Sometimes clouds at different heights move in different directions because of different winds.)
5. How far can you see in today's fog? (Up to the flagpole; ten steps away; up to the apartment house across the street.)

D. A RAINY DAY

Background for the Teacher

The droplets of water which make clouds are kept up in the air by rising air currents. Sometimes the droplets in a cloud come together. When this occurs they grow in size and become heavy enough to fall through the atmosphere as rain. Scientists are still not sure what makes cloud droplets come together to form raindrops.

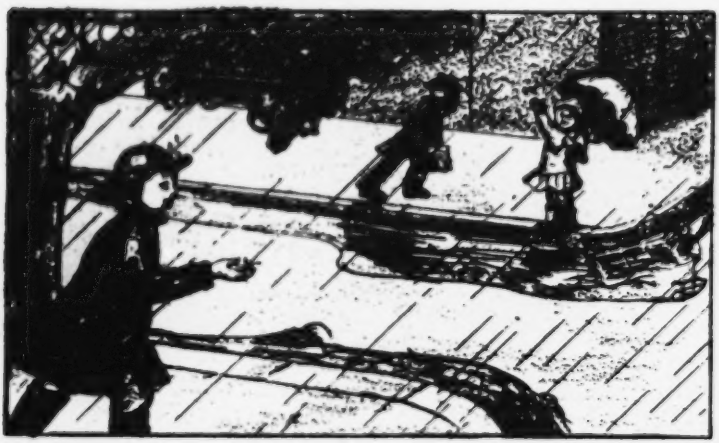
Approaches and Concepts for the Child

"Rain, rain, go away;
Come again another day.
All the children want to play."

This rhyme has passed from generation to generation of children. They well know how rain interferes with their outdoor play. They now learn about the need for rain. Through experiences with rain, by collecting some rain, by experimenting with the effect of rainwater on various materials, children come to a better understanding of the role of rain in their lives.

From the activities suggested, children learn the following.

Rain is water that comes from the clouds.
Rain soaks into some things and not into others.
Some rainwater goes back into the air.



1. How does the sky look on a rainy day?

Observe the sky on a day when a storm is gathering. Discuss with children their observations of conditions before, during and after a rainstorm. Are there clouds present? Do things look bright or dark? What sounds do you hear during a rainstorm? How does the sky look after a rainstorm?

- *Sometimes the sky becomes dark before it rains.*
- *Usually the sky is full of clouds before and during a rain.*
- *Rain is water which comes from the clouds.*
- *Sometimes there is thunder and lightning with the rain.*
- *The sky usually clears after a rain.*

2. What happens when it showers?

Watch the shower from the classroom window. Have children tell about experiences with a shower in which they have been caught. Listen to the noises that the raindrops make striking the roof, window panes, ground, and other objects. See how long it takes the raindrops to wet all of the surface of the sidewalk. Is the rain dripping from trees, awnings, roofs, people? Are any puddles forming? Where? Do puddles form on lawns, on bare soil? Where is all the rain going? Watch it flow from walls, windows, slides, swings, fences, and from sidewalks to gutters. What kinds of work continue during rain; what kinds stop?

- *Some rainwater washes away into sewers, some remains on the surface of things, some sinks into the soil, some forms into puddles.*
- *Raindrops make sounds when they hit things.*
- *Rain washes and cleans some things.*

3. What has the rain done?

Take a walk after a heavy rainfall to see what the rain has done. Notice the shiny appearance of the sidewalks, windows, leaves, tree trunks, lampposts. Look for puddles in the schoolyard, or sidewalks and gutters. What has the rain done to papers, sticks, and other debris along the gutter of the street?

What has happened to the soil around a street tree? If possible, dig in a vacant lot to see how far the water has penetrated into the soil.

What has the rain done to the soil on hillsides, in parks, on lawns or

on vacant lots? Has any of it been washed away and deposited in another place? Did the soil come from grassy or bare areas? Have any earthworms come to the surface? (See page 6 of *Operation New York*, published by the Board of Education, 1960.)

- *Rain collects as puddles in low places.*
- *Rainwater carries small things from place to place.*
- *Rainwater soaks into soil.*
- *Rainwater runs off sidewalks and gutters.*

4. What does rain do to different kinds of materials?

Take a walk just after it has rained. Ask children to observe what rain has done to various materials seen, such as soil, glass, paper, concrete, stone, leaves, stems and trunks of trees.

Get samples of various materials such as stone, cloth, rubber, leather, glass, waxed paper, paper toweling, etc. Drop water on each. Which of the materials soak up (absorb) water? From which of the materials does the water run off? Get children to apply their conclusions to windows, raincoats, rubbers, umbrellas, and other protective materials.

- *Rain soaks into some things and runs off (is shed by) others.*

5. How do we dress for rain?

Note the state of the clothing of children who have worn raincoats in the rain and that of children who have not. If all have worn raincoats, observe the unprotected part of the clothing (such as pants legs).

- *Clothing which sheds water is worn to keep us dry.*

6. How can we collect some rain?

During a heavy downpour, use an open tray to catch rain. After the rain is over, pour the contents of the tray into a glass. Have children examine and dip fingers into the liquid, and tell what they think it is.

- *Rain may be collected.*
- *Rain is water.*

7. What happens to the puddles in our schoolyard?

Visit the puddles several times during the school session, and the next day, and watch them get smaller. On each occasion, outline the puddle with chalk. Where does the water go?

Water from the puddles and from the pan goes into the air.

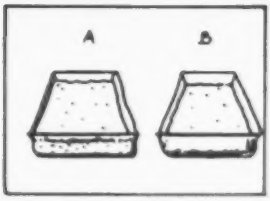
"Paint" with water on the blackboard or other appropriate surfaces and watch the water disappear.

Place a little water in a container on the windowsill in the sun or on the radiator. Mark the water level at this time, and on subsequent occasions. Watch at intervals until there is no water left. Discuss what has happened to the water. Encourage children to apply their conclusions to water in puddles, streets, yards, the aquarium, and on roofs and walls.

- *Rainwater goes into the air.*

EVALUATIVE ACTIVITIES

1. Who likes the rain? Why? (Farmers; umbrella and raincoat salesmen; people in cities which have a water shortage; people whose houses are on fire.)
2. Who does not like the rain? Why? (Car drivers; housewives; people on their way to school or work; baseball fans.)
3. Where does the water go when it falls on soil? (Soaks in; runs over the soil.) On city streets? (Down the street, into the sewer, to the river.) On houses? (Down from the roof and sides of house into drainpipes, onto soil and sidewalks.)



4. Draw 2 pans of water, as shown. Rainwater was collected in this pan (A) on Monday, in this pan (B) on Thursday. On which day did it rain more? (Monday.)*
5. Which is the best for collecting a lot of rain: drinking glass, bowl, pickle jar, barrel? (Barrel.) Why? (Has biggest opening; can hold most.)
6. How do you know that rain is water? (It looks like, tastes like, feels like water.)
7. Why does the water level in our open aquarium go down? (Water goes [evaporates] into the air.)
8. Do we drink rainwater? (Yes.) How? (Rain falls on hills outside the city, collects in streams which run into lakes [reservoirs], then flows through pipes into the city and up to our faucets.)

E. A COLD DAY

Background for the Teacher

Days are cold in winter because there are fewer hours of sunlight for the part of the earth having winter, and the rays of the sun fall on that part of the earth at more of a slant. Slanting rays do not heat the earth as much as vertical rays do for the following reasons.

1. Slanting rays travel a greater distance through the atmosphere than those that strike vertically. The more air they go through, the more of their energy is absorbed along the way and the less is left to heat the surface of the earth.
2. Slanting rays spread over a greater surface of the earth than those that strike vertically. Consequently the amount of the sun's energy warming any given area is less.

Just before water freezes into ice (beginning at 39° Fahrenheit) it expands slightly. As a consequence, ice is lighter than water, and floats on it. It is for this reason that ice forms on the top of ponds and lakes.

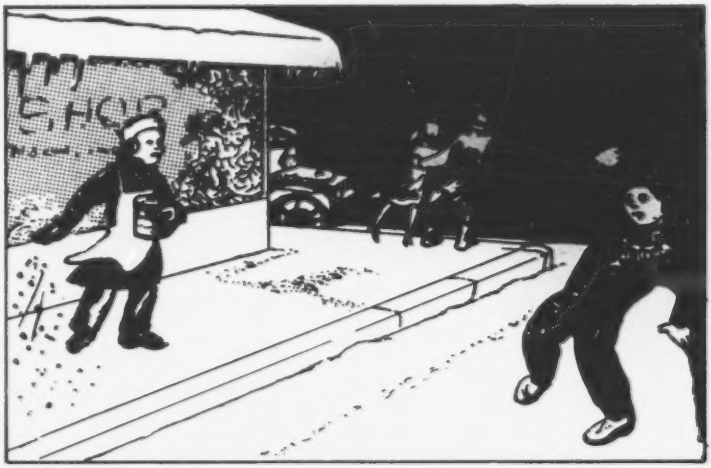
*The letters "A," and "B" are not to be used in your drawing or discussion. The child or teacher will point to the appropriate drawing.

Approaches and Concepts for the Child

Cold weather affects children. They "bundle up" to protect themselves from wind and low temperatures. They touch various materials which have been exposed to cold, observe thermometers, and comment on the weather. Some children are affected more than others by cold and are very expressive about it.

From the activities suggested, children learn the following.

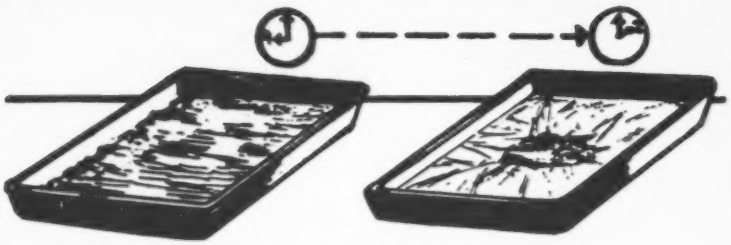
On very cold days, water may freeze and become ice.
Ice forms on the tops of ponds on cold days.
On cold days, the colored line of liquid in the thermometer is shorter.
Salt helps melt ice.
Heat from radiators helps us keep warm.



1. What happens to puddles and ponds on very cold days?

Take a walk to observe the formation of ice on street puddles, and if possible, on ponds and on lakes. Ask the children to suggest ways of making water change into ice. Place water in a shallow dish on the outside window sill when the temperature is 32 degrees or less. Note that ice forms first at the top of the water. How does ice look and feel to the touch?

When a freezing rain occurs, note its effect on cars and trucks and discuss the need for taking precautions against skidding or slipping on ice.



Ice forms first at the top of the water.

- *Water changes to ice on a very cold day.*
- *The ice forms first on top of the water.*
- *Ice feels cold and slippery.*

2. What happens to icicles when they are brought indoors?

If possible, break off an icicle and bring it indoors. Place it in a container and allow it to stand in the warm room. After a while, observe that the ice (a solid) has melted, becoming water (a liquid).

Obtain ice cubes. Compare with the icicle. Feel them. How are they the same? Allow ice cubes to change into water.

- *Heat changes ice to water.*

3. How do different things feel outdoors on a very cold day?

Direct children to feel various things out of doors: iron fences and gates, automobiles, walls of buildings, windows, telephone poles, their own clothing. Ask children to touch cement sidewalks and soil. Let them describe their experiences with the various materials.

- *Some outdoor things feel colder than others on a very cold day.*

4. What happens to an outdoor thermometer when it gets very cold?

Show the children a thermometer. Call attention to the colored liquid in the tube. Mark the top of this liquid with tape, rubber band or string. Hang or place the thermometer out of doors in the shade. Have the children observe the new level of the liquid. (See page 110.)

- *The colored line of liquid in the tube of the thermometer gets shorter on a cold day.*

5. How do we dress on a cold day?

Obtain two containers of cold water. Have children feel the outside of one container with a bare hand, and the outside of the other with a gloved hand. Which hand feels colder? Now try this with a cotton glove, a wool glove, a fur-lined glove. Which keeps the hand warmer?

- *Clothing can help keep us warm.*
- *Some kinds of clothing keep us warmer than other kinds.*

6. How does our school building keep us warm?

Open the windows for a few minutes on a cold day. What happens? Why? How do windows and walls keep us warm?

After a weekend or long holiday the school building may be cold. Call this to the attention of the children. Have them observe the warmth during the latter part of the day and week.

Take the children through unwarmed corridors, stairwells, storage rooms, the gymnasium. Why are these so much colder than their classroom?

Take the children on a trip to the heating plant of the building.

- *Heat from radiators helps keep us warm.*
- *The windows and walls of the building keep warm air in and cold air out.*

7. Why is salt sprinkled on icy sidewalks?

Children often observe the sprinkling of salt on icy streets. Why is this done? Put one ice cube in each of two containers. Sprinkle some salt on only one of the ice cubes. Watch both to see the effect of salt on the melting of the ice.

- *Salt sprinkled on ice makes it melt faster.*

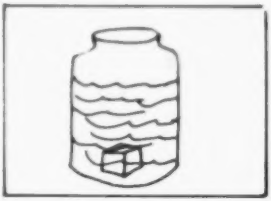
8. Why is sand sprinkled on icy sidewalks?

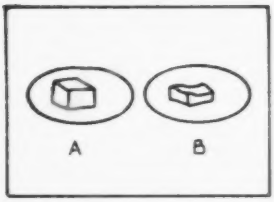
Have children recall that ice is slippery. (Problem 1). Sprinkle some sand on a piece of ice. How does the surface of the ice feel now?

- *Sand sprinkled on ice makes it less slippery.*

EVALUATIVE ACTIVITIES

1. What is wrong with this picture of an ice cube in water? (Ice is shown at bottom of water: it should be shown floating.)





2. Both of these ice cubes were the same size. One had salt sprinkled on it. Which one? (B)

3. How could you tell which of these two glasses of water is colder? (Feel the glass, put finger in water, put thermometers in water.)

4. Why are people sometimes hurt on icy streets? (They slip and fall.) What can we do about this? (Sprinkle salt or sand on ice.)

F. A SNOWY DAY

Background for the Teacher

It is possible, in a single cloud, for the lower portion to consist of water droplets and the upper portion of snowflakes. In the snowflake portion, where the temperature is below freezing, the water vapor condenses directly into snow crystals. When the snow crystals grow sufficiently large, they fall as snowflakes. (Snow is *not* frozen rain.) Each snowflake is a six-sided structure having its very own symmetry, delicacy, and complex design. Snowflakes may come down separately, or they may coalesce into large, fleecy clots.

Approaches and Concepts for the Child

A snowfall evokes immediate, spontaneous responses from children. At the first flurry, there is a move toward the windows. By playing with snow, by bringing some into the classroom, by watching it melt, by making and observing tracks in the snow, children become more familiar with some of its characteristics.

From the activities suggested, children learn the following.

Snowflakes have many interesting shapes.

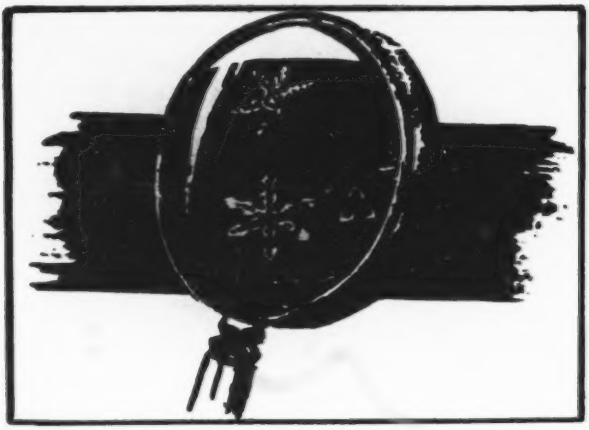
Snow may become icy.

Snow melts to become water.

For safety on snow we wear rubbers, use car chains, salt, and ashes.

1. What happens on a snowy day?

Take the children outdoors on the first snowy day of the season. If this is not possible, observe the snowfall from the classroom window. Observe how the snow falls. Does it fall as fast as rain? Can you hear the snow falling? In what direction does it fall? How soon is the ground covered with snow? Are drifts forming? Where? Why are they forming in these places? Are some spots still bare? Why is this?



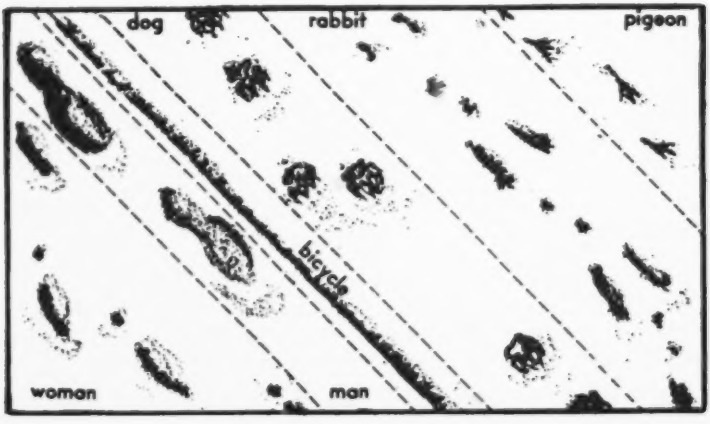
Catch snowflakes on pieces of chilled black paper or cloth. Examine them with a magnifying glass. Can you see snow crystals?

Try to recognize snow-covered objects, trees, cars, lamp posts, fences.

- *On a snowy day, a blanket of snow covers many things.*
- *Snowflakes have many designs.*
- *Wind may make snow pile up higher in some places than in others.*
- *Snow falls very quietly.*

2. What makes tracks in snow?

After a snowstorm take the children for a walk to observe tracks in



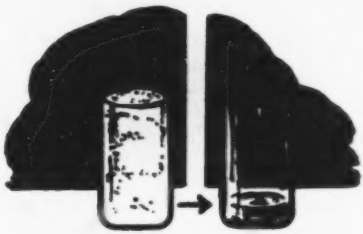
fresh snow. Let them make their own tracks. Ask them to guess what made the other tracks.

Discuss how we can be sure that our answers are right. (One way is to observe the animal or thing while it is making a track.) Look for tracks of autos, trucks, birds, dogs, people, sleds, squirrels, cats, bicycles.

- *We can often tell what moved across snow from the tracks that were made.*

3. What happens to a glassful of snow that we bring indoors?

Take some snow into the classroom in a glass or jar. Let it melt. Compare the space taken up by the water with the original amount of snow. *Note:* The water takes up less space than snow chiefly because air mixed in with the snowflakes makes the snow fluffy.



- *Snow melts to become water.*
- *A glassful of snow melts to only part of a glassful of water.*

4. What happens to snow that is packed?

Have children stamp on a limited area of snow with their feet. Let them tell how that portion of the snow begins to feel. As the snow is packed it becomes icy and slippery. What should be done so that other people will not slip and get hurt here?

If possible, join with the children in building a snowman. Observe that if the snowman is packed hard, it will not melt until nearly all the other snow on the ground has melted.

- *Snow may become icy and slippery when it is packed.*

5. How do we stop cars and people from slipping in the snow?

The children observe autos equipped with snow chains. They see ashes, sand or salt being placed on the snow near buildings. They walk on

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fresh snow and on snow sprinkled with ashes, sand, or salt. Describe the difference between treated and untreated snow.

- *Chains or snow tires are put on car wheels to keep cars from skidding.*
- *Salt is put on snow to help melt it.*
- *Ashes and sand are put on snow to keep us from slipping.*

6. How long does the snow stay white?

Observe the appearance of the snow after a snowfall. What happens to the fresh, white color? The children may observe a section of snow which will not be disturbed for several days, such as the snow on a window sill or in a fenced-off area. For comparison, a piece of cardboard may be placed over part of the fresh snow.

Why is there a difference after a day or so? Children will suggest that soot has fallen on the uncovered snow. To see this more clearly, melt the snow in a clean white dish or pan. Children will observe that dirt particles appear in the water from the melted snow.

- *Snow becomes dirty in the city because soot falls on it.*

7. How are streets cleared of snow?

Children usually observe and regret the almost immediate removal of snow from city streets after a snowfall. Why is the snow removed?

Direct the children's attention to the helpers who work at snow removal and to the implements of snow removal. Have them note materials (ashes, cinders, sand, and salt) used on city streets so that buses can run. Observe the city helpers using large hoses and water from street hydrants to wash snow toward sewers.

- *Hoses and snow plows are used to remove snow from our streets and highways.*
- *We try to remove snow quickly, to make streets safe for traveling.*

EVALUATIVE ACTIVITIES

1. How can you make a glassful of snow melt quickly? (Put it in a warm place.)
2. What happens when snow is warmed? (It melts into water.)
3. How can you tell if something moved across the snow? (It leaves tracks.)

4. After a snowstorm, how can you tell how deep the snow is? (Push a stick into it and see how far it goes.) Is the snow just as deep in all places? (No.) Why? (Wind makes it pile up more in some places.)

BASIC SUPPLY LIST

FOR *WEATHER FROM DAY TO DAY*

*indicates quantity for entire class; other quantities specified are for each group of 4 children

E-1: Science Supply List

*1 Outdoor Thermometer
6 Balloons

G-1: General Supply List

*1 Basin
4 Drinking Straws
4 Straight Pins
2 sheets Construction Paper
2 sheets unlined Paper
2 Pencils
2 sheets black Construction Paper
2 Rubber Bands
*1 ball of String (warp, thread-white)
2 plastic Tumblers

Miscellaneous

2 pieces of cloth
*Old Nylon Stockings
2 Large pieces of Cardboard
*Toy Sailboat
2 Sticks
*1 roll Crepe Paper
Streamers
2 Milk Containers (qt.-size)
Samples of Cloth, rubber, leather, glass,
*1 roll Waxed Paper
Shallow Dish
*1 roll Paper Towels
Gloves (cotton, wool, fur-lined)
Salt
Ice Cubes
Tin Can

Plants in Our Neighborhood

A. ANIMALS IN OUR NEIGHBORHOOD

Background for the Teacher

Life is all around us. A drop of pond water teems with thousands of tiny animals and plants. In a nearby garden or park the soil is alive with bacteria, molds and worms. The air not only carries birds, but also spores of microscopic life, and pollen of higher plants.

The forms of life are many and varied. Cottony bread molds, maple trees, fireflies and squirrels are all living things, all alike and alive because all can reproduce their kind; all can respond to stimuli; all can secure food and obtain energy from it; all can dispose of wastes.

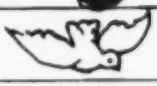
What in common speech is called an "animal" is usually one of the four-footed, fur-bearing mammals. However, animals include such varied forms as birds, fish, frogs, reptiles, mammals (all of which have backbones) and insects, starfish, lobsters, sponges, as well as microscopic one-celled forms, which have no backbone.

Approaches and Concepts for the Child

Even in a city environment many kinds of animals may be seen. The children have an amazing variety of pets in their homes. Animals may be seen on trips to parks, lawns, nearby "empty" lots, at the zoo and in pet shops. Children learn about animals by observing them, listening to them and reading about them. However, no picture, or model, or preserved specimen can substitute for studying living animals.

From the activities suggested, children learn the following.

There are many kinds of animals in our neighborhood.
There are many places in our neighborhood where animals are found.
Animals need air, food, water, and shelter.
Animals swim, hop, crawl, run, or fly.
Some animals build their own homes.
Animals protect themselves in different ways.
Zoo animals come from many parts of the world.

Animal	Where we saw it
cat	on a window sill
bird 	in the sky
worm	on wet ground
squirrel	near a tree
ant	

1. What animals can we see on a walk in our neighborhood?

See how many kinds of animals can be found during a walk in the neighborhood of the school. On this "animal hunt" children may see such animals as dogs, cats, horses, birds, squirrels, spiders, insects, fish, and frogs. They may see a mother cat with her kittens or a mother dog and her puppies.

If possible, have children look under stones and logs, in trees, on plants, on the ground, and along the edge of a pond (if available). List the animals and the places they are seen as the children search throughout the neighborhood.

Back in class the children recall (with the help of the list) the animals they saw. They help prepare a chart which shows the animals and the places they were seen.

- *We can find animals in many places in our neighborhood.*
- *There are many kinds of animals in our neighborhood.*

2. What animals can we see in a pet shop?

Visit a local pet shop to see the kinds of animals in it. The children may see dogs, cats, monkeys, chicks, rabbits, fish, snails, and turtles. They note some identifying characteristics of each kind of animal. They observe how each animal eats; how many legs it has (two, four, more

than four, none); if it has wings, fins; how it moves and what special things it can do.

- *In a pet shop there are different kinds of animals.*
- *Some pet shop animals swim, fly, crawl, hop, or run.*
- *There is something interesting and different about each kind of animal.*
- *Each animal needs its own kind of food, and its own kind of home.*

3. What "story-book animals" can we find in a zoo?

Take a trip to a zoo to see the animals the children have read about, such as elephants, seals, bears, penguins, zebras, giraffes, monkeys, and kangaroos. Try to schedule the visit so that children may see some of the animals being fed. Look for identifying characteristics of each kind of animal: trunk of elephant, hump of camel, long legs and neck of the giraffe, teeth and claws of meat-eating animals, flippers and tail of a seal. Listen to animal sounds. Observe what food is given to the different animals and how it is eaten. Observe animal mothers and young.

- *There are many kinds of animals in a zoo.*
- *There is something different about each kind of animal.*
- *We can know some animals by the sounds they make.*
- *Each kind of animal needs its own special kind of food.*
- *Zoo animals are cared for by the keepers.*
- *Many animals in the zoo come from far-away places.*

4. What "story-book" farm animals have you seen?

Children who have spent their vacations in the country may wish to talk about their experiences. A film or filmstrip depicting farm animals may supplement the discussion. Discuss the outstanding characteristics of each animal and decide why the farmer keeps it: horses for work, cows for milk, steer for beef, chickens for eggs and food, and so on.

Children dramatize how farm animals move, work, and make sounds.

- *Some farm animals supply us with food or clothing materials.*
- *Some farm animals do work for us.*

5. What birds can we find in our neigborhood?

Take a walk to see some birds and notice what they are doing: flying,

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perching, feeding, drinking, bathing, preening (cleaning their feathers), calling. Look for birds' nests in the trees but do not disturb nesting birds. The following birds are the ones most likely to be found in the city: pigeon, starling, English (house) sparrow, robin, grackle, herring gull, blue jay. Children at this grade level need not identify all of them. The children's experiences may be enriched by reading about birds and their young, especially those which children have seen in their neighborhood. Discuss the following: What do they eat? Where do they live? What do they do when we get very close to them? How does the mother bird take care of the eggs? What sounds do birds make?

Show filmstrip, *Exploring New York City for Birds.*

- *Many kinds of birds live in our neighborhood.*
- *We can find out about these birds by watching them and reading about them.*

6. How can we get near enough to watch birds closely?

Place a feeding tray in an appropriate spot, if possible, in sight of the classroom window. Children may try several sites before deciding on a permanent location. Choose a place where cats cannot surprise the birds. A place near trees or bushes which provide cover for the birds is desirable. Try dried bread, suet, seeds, peanut butter, sunflower seeds. Scratch feed may be purchased in pet shops.

Children will see that after the first bird finds the feeding station, others join it; that some birds feed together; some (like the blue jay) drive others away.

A shallow bird bath will also serve to attract birds.

- *Birds come to feeding stations for food and water.*

7. What is that squirrel doing?

Take a walk in a park to observe squirrels. Put out peanuts for them to eat. In the fall, children will observe that squirrels may bury them, just as they bury acorns. Do not allow children to try to catch or touch squirrels, which may bite if frightened. (Running and biting are the squirrel's natural defenses.)

As children observe the squirrels, they try to find answers to questions such as the following: How does a squirrel pick up a nut? What does it do with it? What makes a squirrel run away? Where does it live? How does it get from tree to tree? How does it keep warm?

- *Squirrels are good climbers, runners and jumpers.*
- *Squirrels eat nuts and other seeds.*
- *In the fall squirrels bury nuts.*
- *The fur of squirrels helps keep them warm.*

8. How do some animals protect themselves?

On a walk children may see a squirrel eating. Have them notice the sharp teeth and claws that are also used for protection. Another way squirrels protect themselves is by running fast and climbing. Observe that birds fly away when approached; that frogs and fish swim away. Observe that some insects curl up when threatened, and that some are hard to see because their coloring makes them seem to disappear into the background.

Children may notice dogs barking to warn off their "enemies," and cats spitting and hissing to keep strangers from approaching too closely. If these warnings are ignored, what might happen?

- *Some animals have sharp teeth and claws.*
- *Some animals use sounds to make their enemies run away.*
- *Some animals protect themselves by running or flying away quickly.*
- *Some animals are hard to see. This hides them from their enemies.*

9. What sounds do animals make?

On a walk, ask children to listen for animal sounds such as those made by birds, insects, squirrels, dogs, cats. Children will realize that each kind of animal makes characteristic sounds. Children play games in which they imitate and recognize animals from the sounds made.

Children imitate the moo of a cow, the whinny of a horse, the squeal of a pig, the cackle of a hen, the crow of a rooster. They sing songs, play records and use toys which reproduce noises made by farm animals.

- *Different kinds of animals make different sounds.*
- *Each kind of animal makes its own kind of sound.*
- *We can usually tell what kind of an animal it is by the sounds it makes.*

EVALUATIVE ACTIVITIES

1. Assign children to help you collect a wide assortment of animal pictures cut from magazines. Display these without sorting them and ask such questions as the following.
   a. Which of these animals move mainly by flying? walking or running? swimming? (There may be some overlapping. For example, a duck swims, walks and flies.)
   b. Which have scales? feathers? fur?
   c. Which of these might be found in a pet shop or home? which in a zoo? in the neighborhood? on a farm?
   d. Which are found on trees?
   e. Which of these lay eggs?
2. Reproduce animal sounds, using records or imitations by children. Ask children to identify the animal.
3. Show children pictures of animals which show such parts as: (elephant) trunks, (giraffe) necks, (fish) fins, (squirrel) tails, (rooster) coxcombs, and (cat) whiskers. Ask children to tell how the part helps the animal.
4. Show children pictures to be matched. On the left side of the page or chart show such familiar animals as birds, cats, chicks, rabbits, and dogs. On the right side show such foods as worms, bones, lettuce, and fish. Ask children to draw lines to match the animal with the food it likes.
5. Show children pictures of farm animals on the left side of a chart. Ask children to place on the right side pictures which show the products made from or uses of these animals. Show such animals as chickens, cows, dogs, sheep, pigs; such products as eggs, milk, wool, and hams.

5. Ask children to act out how each animal you name would protect itself. Use such animals as turtles, dogs, birds and frogs.

B. PLANTS IN OUR NEIGHBORHOOD

Background for the Teacher

The two broad groups of living things are the plant and animal kingdoms. The plant kingdom includes such diverse forms as bacteria, yeasts, molds, mushrooms, mosses, ferns, and the plants with seeds.

The seed plants include all of the common herbs, shrubs, and trees. The two major groups of seed plants are the gymnosperms and the angiosperms. In the gymnosperms, seeds are produced generally in open cones, as in the pine tree. Other members of this group are the hemlock, spruce, fir, cypress, yew, redwood, and sequoia.

The angiosperms are the flowering plants, of which there are over a quarter of a million different kinds. The flowering plants generally have thin, flat leaves, in contrast to the needle-like or scale-like leaves of the gymnosperms. They are found as herbs, vines, shrubs, and trees.

A plant is a living organism. Like animals, plants obtain food, use food for growth and for energy, respire, respond to stimuli, and reproduce.

Approaches and Concepts for the Child

As children become familiar with plants in their neighborhood, they become aware that plants vary in size, shape, and other characteristics. They observe the seasonal changes in trees, and study their branches, leaves, seeds, and fruits. Understandings are developed through seeing, touching, smelling, listening and, where appropriate, tasting. We are not interested in teaching isolated facts about plants, but in developing understandings useful in interpreting living things in relation to their environment.

From the activities suggested, children learn the following.

There are many kinds of plants in the neighborhood.

Plants grow in many places.

The common plants we see in our neighborhood have roots, stems, (trunks), leaves, flowers, and seeds.

Plants change with the seasons.

1. Where do we find plants in our neighborhood?

Ask children where they have seen plants growing in the neighborhood. Take a walk to see these places. A garden or park is good; a vacant lot or a street will do. Observe trees on the street, grass or other plants growing in crevices in sidewalks, vines on buildings, plants in window boxes, flowers and growing plants in florists' windows.

- *Plants grow in many places in our neighborhood.*
- *Many kinds of plants grow in our neighborhood.*

2. Why do we plant trees on streets?

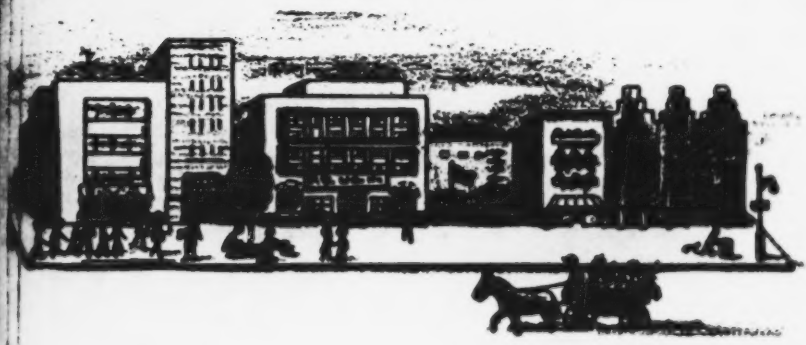
On a hot, sunny day, walk on a street that is shaded by trees. Then walk on a street that is unshaded. Ask children to tell on which street they felt warmer.

- *In hot weather, we feel cooler on streets shaded by trees.*
- *Trees make streets more beautiful.*

3. What happens to "our tree" throughout the year?

"Adopt" a tree near the school. Do this in September. The children will then see a complete seasonal cycle during the school year. Visit the tree regularly to watch its changes.

The class should keep a record of their observations on a chart, keeping in mind such questions as the following. What is the name of the tree? Where is it growing? What shape are the leaves? What color are the leaves in autumn; in spring; in summer? When do the leaves fall? What happens to the leaves that fall? When do the new leaves come out? What color is the bark? Is the bark rough or smooth? Can you see any



seeds on the tree? What becomes of the seeds? Are there buds on the tree in the winter? (Yes.) What happens to the buds in the spring? When do the flowers appear? What color are the flowers? Do you see any insects on our tree? What do insects do to the tree? What birds perch on our tree? What birds do you see nesting in our tree? How is our tree affected by rain, snow or ice? What happens to it during a dry spell?

- *Our tree changes with the seasons.*
- *Our tree is different from some other trees.*
- *Our tree provides protection and nesting places for some birds.*
- *Some insects live in our tree.*
- *Some insects may eat the leaves of our tree.*
- *Our tree is alive in the winter.*
- *Seeds of our tree fall off, and some of them land far from it.*

4. What happens to the leaves in autumn?

After the leaves fall from the trees, take the class for a walk. Let children walk through the leaves noting their sound, color, and odor. They will note that some leaves are crumbling into small pieces, some are caught under bushes and some have been carried along to the sewer grating. They will see some home owners piling leaves in heaps. *Note:* There is a city ordinance against burning of leaves.

- *Some leaves change color in the autumn.*
- *Many trees lose their leaves during autumn.*
- *Leaves crumble after they drop off trees, and may rot to become part of the soil.*

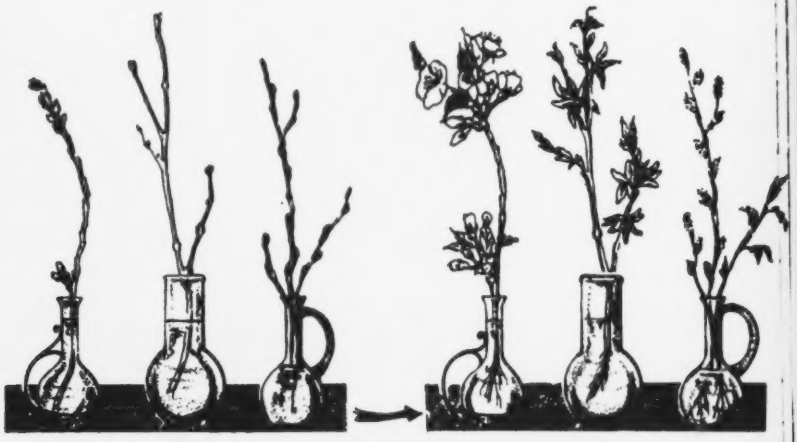
5. How can we make a collection of leaves from trees?

Have children collect different kind of leaves, examine them and note their color, odor, texture, shape and size. They make a leaf exhibit, using their own ideas for arranging or grouping leaves. Some children may wish to make designs with leaves; some may wish to group them according to color or according to the kind of leaf.

Make leaf prints with blueprint paper, spatter paint, or plaster of Paris.

Press leaves between sheets of newspaper weighted with heavy books. When the leaves are dry, mount them on paper with strips of masking or cellophane tape.

- *Leaves from different trees are different in size, shape, color and in the way they feel.*
- *We can arrange our leaf collection in different ways.*



Cherry, forsythia, and pussy willow buds open indoors.

6. Do trees stay alive in the winter?

Children may wonder if a leafless tree is dead. Ask children how they can find out. They may examine twigs in winter and note the buds.

In February or March obtain pussy willow and forsythia branches. Look at the winter buds and then place them in water. Watch them from day to day as they open to produce leaves or flowers.

- *Trees live through the winter.*
- *Buds are alive and will open in the spring.*
- *We can make some buds open earlier by bringing twigs indoors and placing them in water.*

7. Have all the trees lost their leaves by wintertime?

Take the class for walks during the winter months to observe that evergreen trees have leaves in the winter. *Note:* The needles of pine trees are leaves. Look for different kinds of evergreens.

Children may bring in small samples of evergreens, such as spruce, cedar, balsam, fir, holly, and pine during the winter holidays. Let children smell them, noting their fragrance. Have them feel the prickly, pointed needles of the spruce, the soft needles of fir, the generally long needles of pine and the sharp points of holly leaves. Discuss with children why these trees are suitable for use as holiday trees and wreaths. (They are green and attractive in the winter.)

Look for seeds in cones, and for holly berries. Some children may identify the evergreens, but this should not be required.

- *Some trees have leaves all year round.*
- *There are many kinds of evergreens.*
- *Some evergreen trees have cones and some have berries.*
- *Cones and berries contain the seeds of the trees.*
- *Some trees have leaves all year round.*

8. What do we eat that comes from a tree?

Children examine fruits such as apples, cherries, oranges, peaches, and lemons to explore their texture, shape, color, and odor. With their eyes covered they play a "smell and touch" game to identify the fruits. They squeeze oranges and grapefruits to discover how much juice they contain and how they taste. Children share and eat the fruits brought into class.

Make a collection of unshelled nuts such as almonds, walnuts and pecans. Break the shells to examine the nuts inside. *Note:* Peanuts grow, not on trees, but underground, attached to the roots of the low, bushy, peanut plant.

- *Many foods that we eat come from trees.*
- *Most fruits contain seeds.*

- *Some of the fruits that we eat are juicier than others.*
- *We eat some seeds.*
- *Nuts are seeds.*

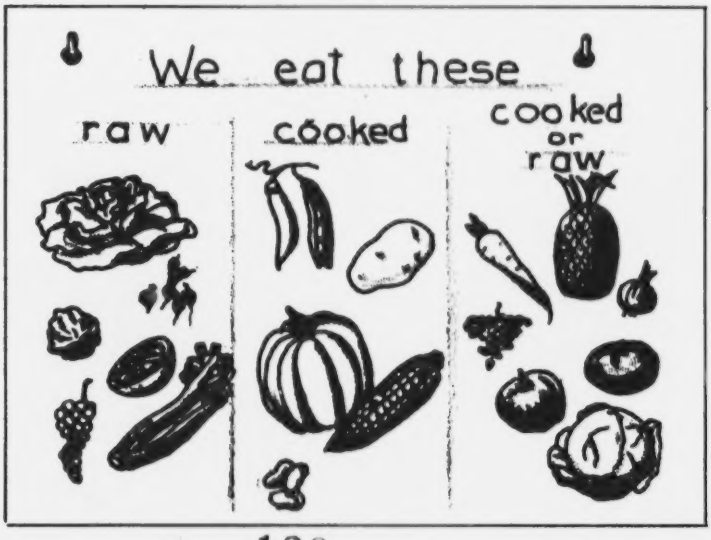
9. What grows in the gardens in our neighborhood?

Prepare an exhibit of cuttings from local gardens. Group those grown for foods, for beauty, and for other reasons. Children may taste mint, chives, and parsley after the leaves have been washed in cold water.

If possible, plan to visit a school garden, or a local garden planted with vegetables, perhaps another containing a strawberry patch or a grape arbor. Before leaving the classroom for such trips, children should discuss precautions to be taken such as: avoid trampling soil, crushing or breaking stems or picking flowers.

In the garden, children should observe the variety and appearance of the plants; they should feel the soil; they should smell flowers, the leaves of herbs, and freshly cut grass. They may feel the texture of flowers, leaves, thorns, and the furry pussy willow buds; the moisture at the tips of freshly cut stalks, the sharpness of burrs and cones. They may discuss the purposes for which the different kinds of plants are grown.

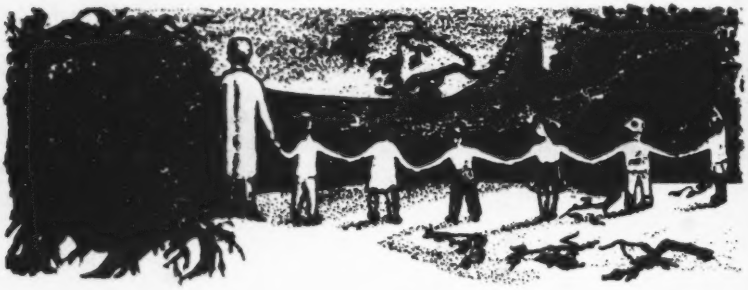
- *Garden plants are grown for food, for beauty, for shade, and for other reasons.*



10. What fruits and vegetables can we find in the market?

Take the children to a fruit and vegetable market. Encourage them to point out and name the vegetables and fruits they like to eat. Ask them how these foods are prepared for eating. Buy some vegetables. In the classroom, wash them thoroughly and allow the children to taste them. Cook some of the raw vegetables and have children taste them again.

- *Parts of some plants are used for food.*
- *Some vegetables are eaten raw; some must be cooked; some are eaten either way.*



11. What did the storm do to the plants in our neighborhood?

After a heavy storm, take a walk to observe uprooted trees, broken branches, and fallen leaves. If possible, have the children walk the length of an uprooted tree to get an idea of its size. Observe the large and small roots which had anchored it, and the soil clinging to them; notice the many branches broken by the force of the wind or the weight of ice or snow. Point out that when children swing on branches they may cause similar damage (as well as endanger themselves).

Look for other signs of storm damage, such as the breaking or bending of stems and the washing away of soil.

- *Strong winds, snow, and ice may damage the trees and other plants in our neighborhood.*

EVALUATIVE ACTIVITIES

1. In the autumn go on a trip in a nearby park to collect the leaves that fall. Note the tree (and its name) from which the leaf came, limiting

the number to two or three trees (oak, maple, elm). Back in the classroom see if the children can:

a. divide the mixed pile of leaves into groups according to the kind of tree from which it came.

b. name the leaves.

2. Present children with a pile of assorted leaves. Ask them to arrange them for the purpose of making an exhibit but do not tell them how to do it. Observe what basis they use for arrangement. (Size, color, texture, shape, kind.)

   Note: The purpose of this activity is to encourage children to use their *own* criteria. For decorative purposes, for example, color may be important to the child, even though two brown leaves may come from different trees. The *kind* (species) of leaf is significant in relation to identification of the tree from which the leaf came. Of course, recognizing a leaf is based on a number of characteristics, such as shape and texture.

3. What animals live on, in or near trees? (Birds, insects, squirrels.) Why is it good for these animals to live on the tree? (Protection, food, shelter.)

4. Is a tree alive? (It may be.) How do you know? (It grows.)

BASIC SUPPLY LIST
FOR *ANIMALS AND PLANTS IN THE CLASSROOM*

*indicates quantity for entire class; otherwise quantities specified are for each group of 4 children

E-1: Science Supply List

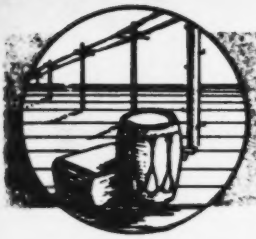
*1 pkg. Blueprint Paper

G-1: General Supply List

*Hot Plate	Masking Tape	Paints
*Sauce Pan	Cellophane Tape	

Miscellaneous

"Scratch Feed" (Suet, Sunflower seeds, dry Bread)	Pussy Willow Branches	Collection of unshelled Nuts
Collection of fallen Leaves	Forsythia Branches	Variety of raw Vegetables
	Evergreen Twigs	
	Variety of Fruits	



Sounds Around Us

A. MAKING SOUNDS

Background for the Teacher

Sounds come from vibrating objects. It is sometimes possible both to see and to feel the back-and-forth motions of these objects. An object that vibrates rapidly produces a sound which is different in pitch from one that vibrates slowly. The more rapid the vibration, the higher the pitch. The vibration of an object, however, does not always produce a sound that can be heard by humans. To produce a sound for the human ear, an object must vibrate between 20 and 20,000 times a second.

Approaches and Concepts for the Child

Children should enjoy this learning experience since it calls for making sounds. By their own investigations they discover the peculiar sounds made whenever various objects in the room are struck. They find out how toy musical instruments are set into vibration to produce musical tones. Children play with simple (rhythm band) instruments and discover different ways of making sounds by tapping, clapping, shaking and blowing.

From the activities suggested, children learn the following.

When sounds are made, something has to vibrate (shake or quiver).
There are many ways to set an object into vibration.
Different kinds of objects vibrate to make different sounds.

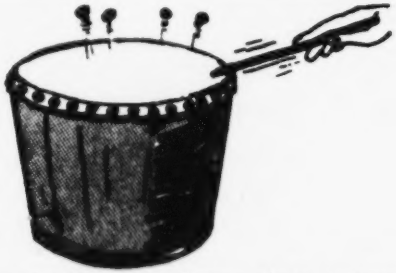
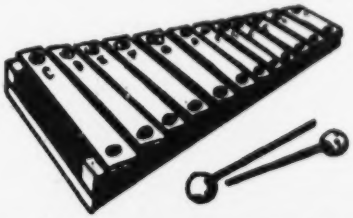
1. What kinds of sounds can we make with various objects in our classroom?

A pencil, ruler or small stick is used to tap various objects around the room. The following may be suggested by the children: windowpane, window frame, radiator, dish, window box, doll house, aquarium, blocks, chalkboard, chalkboard frame, easel, faucet, sink, glass, jar, milk container, flower pot, chair, chalk box, desk, floor, bulletin boards, wall. Ask children to describe sounds (squeak, clink, hiss, for example).

- *When tapped, different objects make different sounds.*

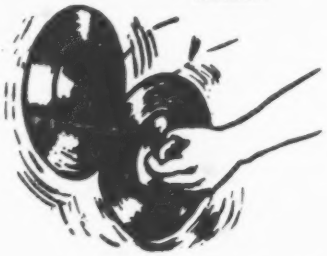
2. How do our musical instruments make sounds?

Children experiment with musical instruments to find out how they are played and to understand some of the principles involved in the production of sound. Some suggested instruments, activities, and learnings:

WHAT CHILDREN DO	WHAT CHILDREN LEARN
 **Drums**	
Play on them with sticks or hands. Place tightly-rolled bits of paper or puffed wheat on drumhead. Tap to see them dance.	Drums shake (vibrate) while they are played.
Hit drum gently; hit drum hard.	A hard tap makes a louder sound than a gentle tap.
Play on small drums and big drums.	Small drums make high sounds; big drums make low sounds.
 **Xylophone**	
Strike the bars with the sticks.	The long bars make the low sounds; the short bars make the high sounds.

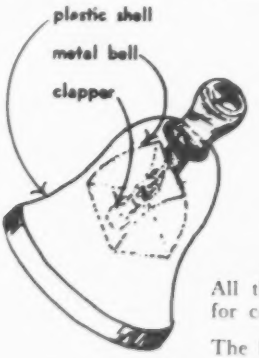
Piano

Notice how sound is produced when key is struck. Notice that strings are of different lengths.	Felt-covered hammers strike strings to make the sounds. Short strings make high notes; long strings make low notes.
Feel piano while it is being played.	When piano is played we can feel vibrations.
Have children place ears against any part of piano as a key is struck.	We can hear distinct sounds when we place an ear against a vibrating surface.



Cymbals

Strike cymbals. Listen.	Cymbals makes sounds when they strike each other.
Strike cymbals. Touch surface or edge of one with fingertips.	While cymbals are sounding they shake.
Rub one of the cymbals gently with fingers.	Rubbing a cymbal produces a muffled sound.
Strike the cymbals. Put your hand on one of them.	Putting your hand on a sounding cymbal stops the sound.



"Melody Bells"

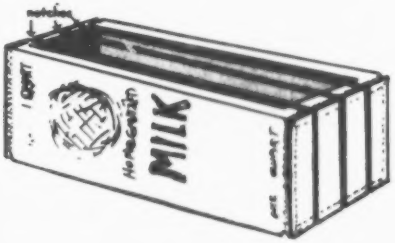
Look at the bells.	All the bells look the same except for color.
Ring the bells.	The bells make different sounds.
Examine the insides of the bells.	Each bell has a metal bell inside which makes the sound. The metal bells are different in size.
Ring a large metal bell. Listen. Ring a small metal bell. Listen.	The large metal bell sounds different from the small metal bell.

WHAT CHILDREN DO	WHAT CHILDREN LEARN
Triangle	
Strike triangle. Listen to it.	The triangle makes a sound when we strike it.
Strike it again. Touch it with fingertips.	While sounding it quivers (vibrates).
Grasp triangle firmly and strike it.	If it is held in the hand and struck, a dull sound is produced.

- *We play some musical instruments by striking them.*
- *While these instruments are giving off sound, they are shaking (vibrating).*
- *When the shaking stops, the sound also stops.*
- *In our musical instruments, large objects play low notes; small ob-objects play high notes.*
- *The harder the object is hit, the louder the sound.*
- *Different kinds of materials (metal, wood) make different sounds.*

3. How can we make our own rhythm instruments?

Some rhythm instruments that can be constructed easily are illustrated here.



Guitar

Cut opening in side of milk carton, leaving 1" margin all around. Select three identical rubber bands. Make notches to keep them in place. Tune by tightening the part of the rubber bands over the opening. Pluck them to play.

To help children "see" vibrations, tie a thread to a grain of puffed wheat. Pluck the rubber band. Allow the grain to touch the vibrating rubber band. What happens? Try this puffed wheat "vibration detector" with other sound makers.

Turn guitar on one side. Sprinkle sand or salt on upper side. Pluck rubber band. Watch grains dance up and down.

Drum

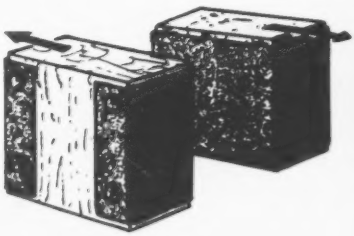
Remove top and bottom from a coffee can. Cover one end with rubber from a large balloon or inner tube, pulled tight. Bind with a string. (New type coffee cans with plastic tops make very good drums.)

Make a drumstick from a pencil. Pad the pointed end with absorbent cotton covered with a square of cloth, tied on with string.

Chime

Remove one end of a "tin" can. Suspend can by a knotted string inserted through a hole in the other end. Strike with a large nail. Try cans of various sizes.

A length of thin plumbing pipe, preferably brass, makes a pleasant musical chime.



Rhythm Blocks

Obtain two small blocks of wood such as those found in kindergarten supplies. Wrap fine sandpaper around each and fasten it at the back with thumbtacks.

Cymbals

A pair of old pot covers can serve as cymbals.

As children make, use and enjoy rhythm instruments, they may deepen their understandings of such principles as the following.

- *Sounds are made by striking, plucking, rubbing.*
- *When the sounds are made, something has to vibrate (shake, "shiver," [illegible]).*
- *Different kinds of objects make different kinds of sounds.*
- *Tapping, plucking or rubbing harder makes the sound louder.*

4. How does the wind make different sounds?

On a very windy day, ask the children to listen to the sounds of the wind. Take a walk outside to listen carefully to the different sounds made as the wind whips flags, rustles leaves, and roars through courtyards. The children will begin to understand that the sound made depends on the object into or around which the wind blows.

Back in the classroom, have the children imitate some of these sounds by blowing into their cupped hands, across the edge of a piece of paper, into an empty bottle, and into a whistle.

Discussion of the sounds of the wind that children hear at night should help alleviate fears they may have. They should understand that some peculiar sounds are caused by the wind (moving air) blowing into or around certain objects.

- *Many kinds of sounds can be heard on a windy day.*
- *Wind sounds are made by air passing through or around various objects.*
- *We can imitate some of these sounds by blowing on different objects.*

EVALUATIVE ACTIVITIES

1. Give each child a long strip of paper and a short strip of paper in preparation for his activity. Play a scale on the xylophone to help children recall the range of sounds produced by the xylophone. Then put the xylophone where the children cannot see it. Play a high or a low note. Ask children to hold up a long strip of paper if they think a long bar made the sound; a short strip if they think a short bar made the sound. Repeat using other notes at the extremes of the instrument. Repeat, using a piano.
2. Give each child a small piece of paper or aluminum foil. Ask children to see how many ways they can find to make a sound with the paper. List their suggestions on the chalkboard. (Shake it, blow across it, hold it up and hit with a pencil, crumple it, drop clips on it, tear it.)
3. Hold up two tuning forks. Have children close their eyes. Strike one tuning fork on a rubber stopper. Have children open their eyes. Show them both forks. Ask which one they think is making the sound. Discuss. Ask how we can find out. Try out all suggestions. The more suggestions given, the better. (Bring your ear close to each; stand one on the table and listen; touch with paper; touch with the hand; put in water.)

4. Strike a large bell. How is the sound being produced? (Vibration.) Ask children to suggest and try may ways of stopping the sound (example: placing hand on bell, holding bell against wall, dipping bell in water). Ask children how they could tell that the bell was making a sound, if their ears were closed so they could not hear. (Touch it; allow it to touch another object.)

BASIC SUPPLY LIST

FOR *SOUNDS AROUND US*

*indicates quantity for entire class; other quantities specified are for each group of 4 children

E-1: Science Supply List

*3 Xylophones
*3 sets Melody Bells

G-1: General Supply List

2 Rulers (12")
4 Pencils
*2 large Drums
*2 small Drums
*2 pair Cymbals
*2 Triangles
1 pair Scissors
6 Rubber Bands (identical size)
2 large Nails
6 small Wooden Blocks
1 sheet of Sandpaper
*1 pkg. of Absorbent Cotton

Miscellaneous

2 Coffee Cans with plastic lids
2 large Balloons
2 Cloth squares
2 Milk Containers (qt. size)
*1 cup of Puffed Wheat (or Rice)
2 empty frozen Juice Cans
*Assorted empty cans of various sizes
1 pair old Pot Lids
*Empty Bottles of different sizes
2 Whistles

A. ROLLING ALONG

Background for the Teacher

An object is made to move or stop moving by the action of a force on it. From experiences with wagons and bicycles, children learn what happens when they start or stop suddenly, or when they go around turns rapidly. The experience of being thrown forward when a moving vehicle makes a sudden stop, or the experience of falling backward when a motionless vehicle makes a sudden start is explained in the first of the Laws of Motion (also called the Law of Inertia) formulated by the English scientist, Sir Isaac Newton (1642-1727): an object in motion tends to keep moving in a straight line; an object at rest tends to remain at rest, unless acted upon by a force.

One of the forces opposing motion is the force of friction. Friction (the rubbing of two surfaces against each other) must be overcome if one is to keep an object moving. It is due in part to the many irregularities on even the smoothest of surfaces which come in contact with each other. There is less friction, however, when things are rolled on a rough surface than when they are dragged. The invention of the wheel thus enabled man to substitute rolling friction for sliding friction.

Approaches and Concepts for the Child

Children become aware of wheels very early in their lives. They play with many toys which have wheels. They see cars, buses and trucks moving on wheels in the street. They discover with their own muscles that objects can be moved more easily on wheels than when dragged.

From the activities suggested, children learn the following.

Round objects roll best.

It is easier to roll things on wheels than to drag them.

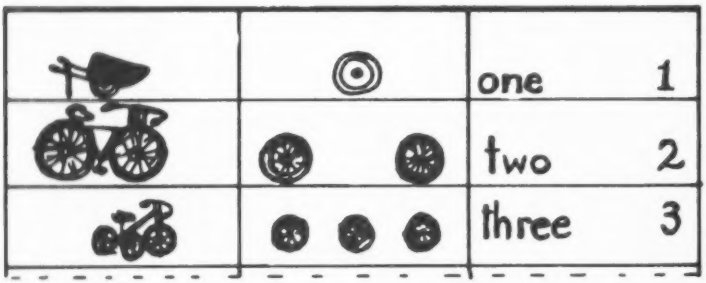
To be safe when we ride on wagons and bicycles, we should stop slowly and go around curves slowly.

1. What moves on wheels on our street?

Conduct a neighborhood "hunt" to find various kinds of vehicles such as school buses, passenger cars, delivery trucks, fire engines, ambulances, sanitation trucks, and vending wagons. To these may be added such familiar items as bicycles, tricycles, wagons, roller skates, and baby carriages.

Make a chart of the vehicles seen on the "hunt." Illustrate with sketches made by children or with magazine clippings. Are there any land vehicles that do not use wheels? (Example: sleds.)

- *We see many different kinds of cars and trucks on our streets.*
- *Most vehicles which move on land have wheels.*



2. Do all wheeled vehicles have the same number of wheels?

Have children bring in toy vehicles from home. Ask them to show how their vehicles operate.

From a study of the experience chart developed as a result of the trip suggested in Problem 1, or on a second trip, children note the positions and number of wheels on vehicles. For example, a wheelbarrow has one wheel; scooters, bicycles and motorcycles have two wheels; tricycles and delivery carts have three wheels; and other cars and trucks have four wheels. Many larger trucks and trailers have six or more wheels.

Children may also comment on the size, spokes, hubs, tires, and other characteristics of various wheels.

Encourage children to speculate on the advantage in the particular number of wheels which different vehicles have. For example, they may say that a wheelbarrow has one wheel because that makes it easy for a man to push and turn it around in difficult places: up a narrow ramp, around

a corner, over irregular ground. A large truck may have ten wheels to support a heavy load. A tricycle has three wheels because it is easier for a young child to ride it without tipping over. A bicycle has two wheels because that makes it lighter than a tricycle of the same size would be.

A chart, with attached drawings or color reproductions, may be developed to record the vehicle and the number of wheels it has.

- *Cars, trucks and other things that roll have different numbers of wheels.*
- *The number of wheels a vehicle has depends on what it is used for.*
- *Wheels come in different sizes, are made of different materials, but all have the same shape. They are all round.*

3. Do the wheels on a wagon help us move things more easily?

If possible, a real situation where a heavy load needs to be moved should motivate this problem. Children may be asked to suggest how a load of books, paper, or blocks in a large cardboard carton may be moved across a room or to another classroom. Compare the effort needed to slide the carton across the floor with that needed to roll it on a wagon. One way of making this comparison is by seeing how many children are needed to make the load move in each case. If the carton is sturdy enough the load may consist of one or two children, standing or crouching inside the carton.

- *Moving a heavy load on wheels is easier than dragging it.*

4. In what ways are the cars and trucks on our streets used?

Observe the different vehicles on the move in the community and discuss their uses. Children see vehicles that carry passengers, milk, oil or coal, collect garbage, pump water, pave streets, put out fires, or sell ice cream. How is the car or truck built for its job? For example, an oil truck has a tank, a pump and a hose; a bus has large doors to permit passengers to enter and leave the bus; a garbage truck may have a mechanical loader which smashes the garbage and pushes it into the truck.

Have children bring in toy models of such vehicles. Ask them to explain how each one works.

- *Cars and trucks are made and used in different ways.*

5. What makes our toy cars and trucks move?

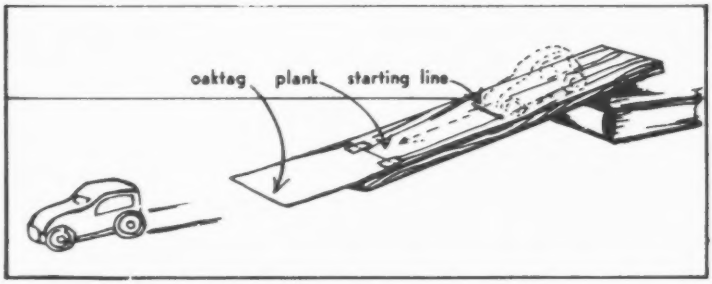
Ask children to select toy vehicles from their collection and have them show what makes them move. Some are moved by a push or a pull.

Some of the toys are driven by wind-up springs, and some by electric motors run by dry cells. Many begin to move when they are put on a slide or ramp. (Such a slide represents the slope of a natural hill.)

- *Pushing or pulling makes some toys move.*
- *Wound-up springs makes some toys move.*
- *Electric motors make some toys move.*
- *Toys placed on a slide may begin to move without a push.*

6. Will a toy car roll farther from a steeper slide?

From the previous problem children have learned that releasing a vehicle on a slide will cause it to move. Now they will seek to discover what effect the steepness of a slide has on the distance it will move after leaving the slide.



The steeper the slide, the farther the car rolls.

This activity can be conducted in the basement, the schoolyard, or the classroom, provided that enough space is available. Obtain a bench with retractable legs from the lunchroom, or use a large plank. Place on the floor or ground (with the legs of the bench retracted.) Attach a piece of oaktag to one end with cellophane tape. (This provides a runway to the ground, insuring a smooth and uninterrupted course.)

Place a few books underneath the opposite end. We now have a slide or ramp upon which a toy car or truck can travel. (Use a toy in which front wheels *cannot* be turned or steered.)

Make a chalkline somewhere near the middle of the bench to serve as the starting point each time the vehicle is released. After every successful

run, the distance the car rolls is measured, and the ramp is raised by adding one or two books to the pile supporting the bench. Note the distance the car travels in each instance by either placing chalk marks at the point it comes to rest, or by having children stand as markers.

Children will find that when the slide is very steep (almost vertical), the car does not go as far as previously. Why? (The impact of the car hitting the bottom uses up a good deal of the energy.)

Discuss the safety implications of this experiment. What care must be taken in cycling or skating down steep hills?

- *The steeper the slide, the farther a toy car will roll after it reaches the bottom.*

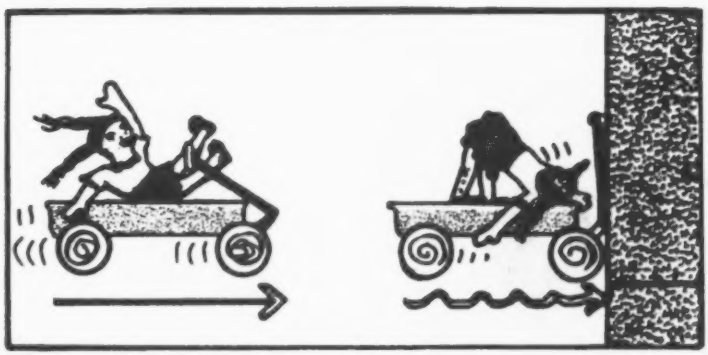
7. How can we make a toy car roll farther without making the slide steeper?

Children may hypothesize that if the car has a *longer* run on a slide, it may go farther after it leaves the slide. Utilizing the materials of the previous activity, determine whether releasing the toy car higher up on the slide will cause it to roll farther.

Children compare the length of the slide and the distance the car rolls from it.

- *The longer the run on a slide, the farther a toy car will roll after it reaches the bottom.*

8. What happens when a car suddenly starts or stops moving?



The wagon starts moving, but the doll does not.

The wagon stops, but the doll keeps moving.

Ask children to tell of their experiences when cars, school buses, or subway trains start or stop suddenly.

Seat a doll or puppet in a toy wagon (or on a roller skate if no wagon is available). Set the wagon into motion with a sudden pull on a string which is attached to the front of the wagon. Observe that the doll or puppet falls backward. Seat it upright again. Set the wagon into motion slowly. Stop the wagon quickly by having it strike an obstacle. The children observe that the doll or puppet falls forward. What does this have to do with the safe way to stop when riding a bicycle?

Discuss what happens to passengers when a vehicle starts or stops suddenly. Why is it important to fasten your seat belt? Why is it necessary to hold on to straps and poles when riding in a subway?

- *We fall back when a car starts suddenly.*
- *We fall forward when a car stops suddenly.*
- *Straps, poles or safety belts are used to keep us from falling when a car starts or stops.*
- *To avoid falls, we should stop our bicycles slowly.*

9. How fast can you turn a corner?

Have children try turning a corner while walking and, again, while running. Have them do the same on a sharp curve chalked on a schoolyard pavement. They will observe that it is difficult to stay on the line when they move fast.

Children tell what happens when their toy electric trains round a sharp curve too rapidly. They will recall that the trains may jump the tracks and overturn. The class may also observe toy automobiles tip to one side as they turn around corners. They discuss how they, too, find themselves leaning to one side when the car they are in makes a rapid turn.

- *It is easier and safer to move around a corner slowly than rapidly.*
- *When a car turns a corner fast, passengers are tilted to one side.*
- *When riding a bicycle, we should slow down on turns.*

10. When do the cars and trucks on our street start and stop?

Take a trip around the block to watch the flow of traffic. Observe the control of traffic by policemen, by traffic lights, and by signs. What do drivers do when they are about to turn a corner? What do they do when they park their cars? When is it safe for people to cross the street?

Back in the classroom, children may dramatize traffic situations. Use car models and blocks to set up an indoor "street," with traffic controls.

What safety rules should we follow when we play in or cross streets?

- *Traffic is controlled in a number of ways.*
- *Traffic control is needed for the safety of riders and walkers.*

EVALUATIVE ACTIVITIES

1. Remove top and bottom from two empty food cans. Squeeze one can out of shape so that the ends are elliptical. Ask the children, "Which can will roll better?" Do the children suggest doing a controlled experiment? (Roll both cans down a similar incline from the same point, without pushing, and compare the distance each rolls.)
2. Which object will roll best? Have various materials on the table: balls, pears, plums, prunes, hexagonal crayons, soft modelling clay made into off-round shapes, pretzel sticks. Do children set up controlled experiments (see #1, above) and test their predictions?
3. What can you do to walk and ride more safely on the street? (Look carefully, move slowly, keep to the right, obey traffic lights.)

B. FLOATING ALONG

Background for the Teacher

A liquid such as water exerts an upward force on an object placed into it. This upward force is called buoyancy. Whether or not an object will float in water depends on the relationship between the buoyant force and the weight of the object. For example, a one-pound block of solid iron will sink in water because the buoyant force pushing upward on it is not sufficient to keep it floating. Suppose, however, that the block of iron is hammered into a thin sheet and then shaped into a hollow form like that of a boat. Now when this "boat" is put into water it floats.

An explanation of this is given in the statement of *Archimedes' Principle*. It will suffice here to say that in its new shape, with its increased volume (but same weight), the upward force on the iron boat is *greater* than it was on the solid block of iron. On the other hand, a block of pine wood, the same shape and size as that of the original block of iron will float because it weighs less. Even when it is in this block shape the buoyant force of water is sufficient to keep the wooden block afloat.

Approaches and Concepts for the Child

A trip to one of the many busy waterways of New York City provides opportunities for for children to see many different kinds of boats that move on water.

Children have experiences at ponds and beaches, where they play with toy boats in water, launching them, sinking them and blowing at their sails. In the classroom they make boats from simple materials such as cork, wood, and milk cartons and float them in a tub or basin.

From the activities suggested, children learn the following.

Some objects sink, some float on water.

Of two objects of the same size and shape, the lighter one is more likely to float.

Rafts and boats may tip over if their load is not properly balanced.

1. What things float? What things sink?

Children suggest a variety of items to use in a "float-or-sink" test. Objects made of wood, paper, cork, foil, plastic, rubber, metal, stone, cloth, and other common materials are placed in a large container of water. They compare their predictions with the results, and note which objects sink and which float.

- *Some things float in water.*
- *Some sink in water.*

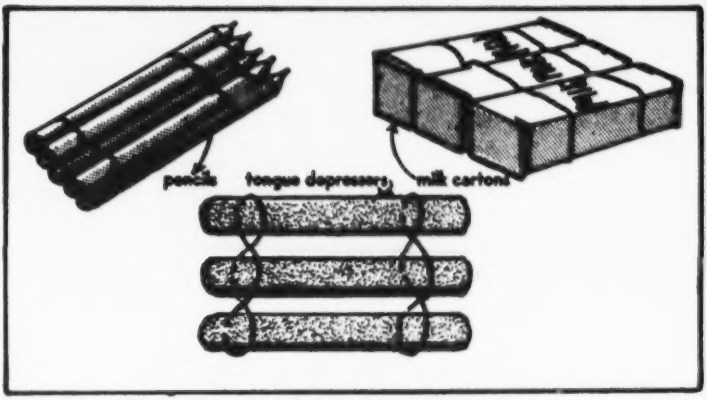
2. Why do some things float? Why do some things sink?

Have the children hold paired objects of similar size and shape, and judge which one of each pair is heavier. Examples of such pairs are pebbles and corks; needles and toothpicks; wooden beads and marbles; and wooden bars and bar magnets. Put each pair in the water. What happens? (Dry the bar magnets after this activity is over.)

- *Of two objects the same size and shape, the lighter one is more likely to float.*

3. How can we make rafts and boats for an indoor pond?

Ask children to tell about their experiences with rafts or boats. Have children suggest various materials which could be used to construct rafts. Some may propose lashing together, with string or rubber bands, such

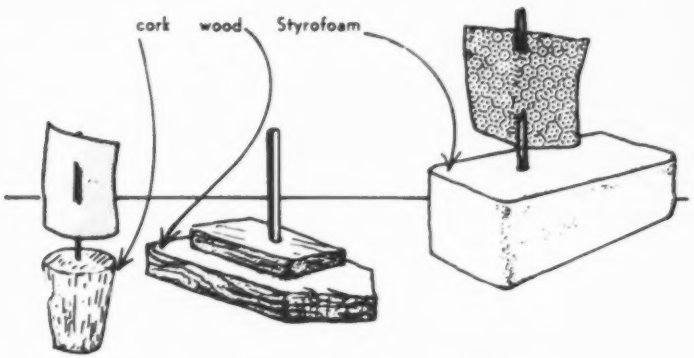


Three simple rafts which children can make.

things as pencils, popsickle sticks, paste sticks, or tongue depressors. Children may want to conduct a preliminary "float test" to determine whether a single pencil or other suggested object will float.

A pontoon raft may be constructed by attaching a platform to several closed plastic bottles. Houseboats sometimes have pontoons to keep them afloat. Children may want to simulate the use of life rafts by placing toy figures of people on them. Polystyrene boats and rafts can be made in many different shapes. (Polystyrene can be purchased from 5 & 10 cent stores at the artificial flower counter.)

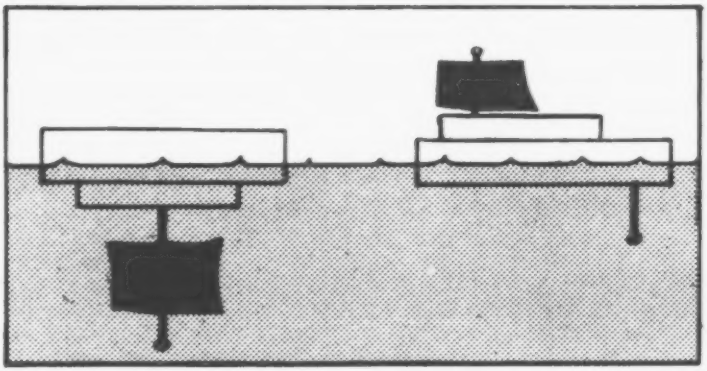
- *Rafts may be made by tying together a number of objects which float.*
- *Things filled with air are good for making rafts.*



Three simple boats which children can make.

4. How can we keep boats or rafts from tipping over?

Children make boats with cork, balsa wood or polystyrene. A long nail or stick serves as a mast. Children often find that their boats tip over. This is a good "teachable moment": ask the children how to make their boats steadier. They may experiment by using shorter masts, or by pushing the mast down lower through the deck so that part of it protrudes from the bottom of the boat. They may try turning the boat upside down, with the mast under the boat. In doing this they have converted their mast into a keel. Sailboats have keels to help balance the vessel and to prevent the boat from tipping over.



After this boat overturned, we decided to make a boat which has a nail for a keel.

Have children conduct a "tip test." This consists of trying to capsize a boat by pushing on the mast. Then try tipping the boat after a keel is installed (a nail). If the boat rights itself, then it is in proper balance.

- *Sailboats are steadier when the mast is lower.*
- *Sailboats have keels (weights) at the bottom of the hull (underwater) to help balance the hull.*

5. How should we load a boat or a raft to prevent it from tipping?

Children make rafts as suggested in Problem 3. They then try loading the rafts with various materials, such as marbles, chalk, thumbtacks, and plastic discs. The children experiment by placing the load at different points on the raft. What happens when the load is too near the

edge? They also try distributing the load on different parts of the raft. The children discover that a raft will support a load better if it is placed in or near the center or if the load is balanced (that is, distributed equally).

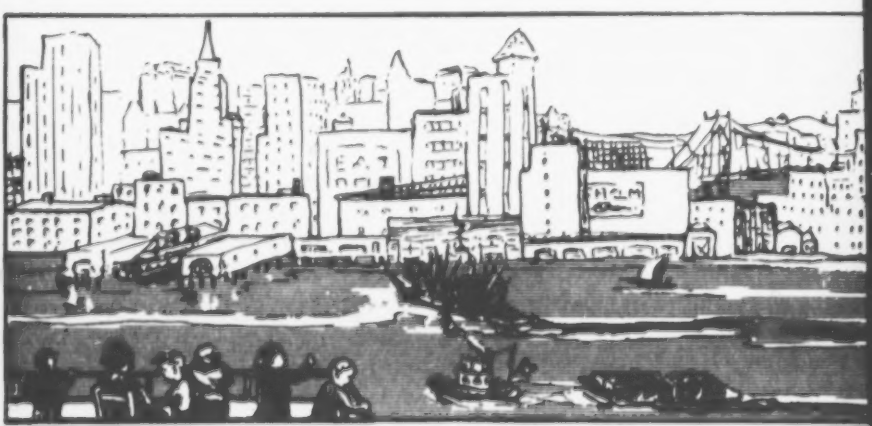
Emphasize the safety implications of placing people in a boat so that the boat remains balanced.

- *Rafts can support loads without tipping if the load is placed in or near the center.*
- *Rafts or boats may tip over if the load is placed near the edge.*
- *Rafts support loads without tipping if the load is balanced.*

6. How can we have an indoor boat show?

Note: If it is feasible, plan to observe ships on one of the rivers or bays of New York City. Listen for the toot of boat whistles, the puff of tugs, the sound of water lapping against the tugs and barges and other craft tied to the docks. Watch river traffic. Find boats carrying freight, such as barges pulled by tugs, and ships such as tankers and freighters. Find passenger boats, such as sightseeing boats, yachts, ferries, and the great passenger ships or ocean liners.

Ask the children to bring in and demonstrate their homemade and store-bought toy boats. Have them tell the class what kinds of boats they are and what makes them go. The class will learn that some toy boats have spring-wound or rubber-band motors to make them go. Others have small battery-operated electric motors. Some have sails which catch the wind. Some need a push or a pull to make them go. Others move only when the water itself moves.



- *There are many kinds of toy boats.*
- *Some boats are moved when we push or pull them.*
- *Some boats are moved by wind, electric motors, springs, rubber bands or water currents.*

7. What helps people stay afloat when a boat sinks?

Children discuss experiences with various water flotation (safety) devices. Life jackets used on ships and boats contain lightweight materials such as cork, polyethelene or kapok.

Life rafts on many aircraft are automatically inflated with a gas (usually carbon dioxide) when the raft hits the water. What keeps these objects on top of the water? Blow up a balloon; tie the neck and attach a weight to it (several paper clips). Place in a basin or tank of water. Does the balloon stay on top? Puncture the balloon with a needle. What happens now? What happened to the air in the balloon?

- *Many water floats are filled with air to keep them afloat.*
- *Some life jackets are filled with material lighter than water.*
- *A life raft or float will sink if too much weight is placed on it.*

8. What happens when an inflated balloon is pushed under water?

Have children push an inflated, closed balloon under water in a deep aquarium, plastic tank or sink, and hold it there. Ask them what they feel. They report on the upward push of the balloon on their hands. What causes this push? (The water presses on the balloon.)

Try the same experiment with empty metal food cans with plastic lids, or a tightly closed milk container. Try holding the container under water in different positions. Does position make a difference in the upward push? (No.) Try partly filling a container with sand or water. Does this make a difference? (Yes.)

- *It is hard to push some things under water.*
- *Objects in water are pushed up by the water.*

9. How can we make our food container boat sink?

Have children observe the level at which their empty food-container boat (a coffee can with top lid removed) floats in water. Ask for suggestions about how to sink the "boats". Some may suggest tipping the boat. They do this and they observe how it fills up with water and sinks. How can we sink the boat without tipping it? Some may suggest adding weights to it, such as pebbles, sand, marbles, gravel or water. They will see that as more weight is added, their container boat floats lower in the water until it finally sinks.

- *When weight is added to a boat, it floats lower in the water.*
- *If enough weight is put into a boat, it sinks.*

EVALUATIVE ACTIVITIES

1. Show the following objects: closed empty jar; sheet of aluminum foil; aluminum foil folded in the shape of a tray; jar cover; block of wood; nail; air-filled balloon; closed jar, full of sand. Ask which objects will float. Children check by placing objects in water.
2. Should you stand or change your place in a boat while someone is rowing? Why not? (Boat may tip over.)
3. Place a narrow olive jar in the water. Use a rubber band to mark the water level on the jar. Have a child add 5 marbles and mark new water level on bottle. Add 5 more marbles and mark water level again. Ask: "What do you think will happen if we add five more marbles?" (Jar will sink; jar will go lower; jar will go this much lower.)

BASIC SUPPLY LIST
FOR *MOVING ON LAND AND WATER*

*indicates quantity for entire class; other quantities specified are for each group of 4 children

A. Rolling Along

E-1: Science Supply List

*2 inclined planes

G-1: General Supply List

2 sheets Oaktag
*1 roll Cellophane Tape
*2 Dolls or Puppets
*1 Toy Wagon
2 pieces of Chalk
*1 ball of String (warp, thread-white)

Miscellaneous

*Toy Vehicles
*1 Roller Skate
*1 Cardboard carton

B. Floating Along

E-1: Science Supply List

6 Balloons
*3 cups of Sand or Gravel

G-1: General Supply List

2 pieces of Chalk
*1 Box of Rubber Bands
*2 Basins
8 Pencils
8 Paste Sticks
8 Tongue Depressors
*1 box Thumbtacks
*1 pkg. Tapestry Needles
*1 box Paper Clips
*1 box Nails
*1 doz. plastic Discs
3" x 5" Balsa Wood
*1 ball of String (warp, thread-white)

Miscellaneous

*Objects made of wood, paper, cork, foil, plastic, metal, cloth
8 Popsicle Sticks
3 plastic Bottles
*Polystyrene (flower counter at five-and-dime store)
*Model Boats
*Toy Boats
2 Coffee Cans with plastic lids
2 milk Containers (qt. size)

The following are paired objects of similar size and shape:

Pebbles and Corks (E-1)
Tapestry Needles (G-1) and Toothpicks (misc.)
Wooden Beads (G-1) and Marbles (Misc.)
Wooden Bars (Misc.) and Bar Magnets (E-1).

Grade Two

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Animals and Plants in the Classroom

A. ANIMALS IN THE CLASSROOM

Background for the Teacher

The basic life functions in all animals are the same, regardless of the seemingly vast differences among them. Animals characteristically respond to stimuli, secure food and oxygen, move, grow, and reproduce.

Some animals, such as fish, are adapted for living in water. They absorb, through their gills, the oxygen which is dissolved in the water. Their muscular tails furnish the power for locomotion, while their fins are used mostly for balance.

Frogs live entirely under water only in the early part of their development. In this stage they are known as tadpoles and have gills and tails which enable them to live like fish. As they get older, however, the external gills disappear and are replaced by internal gills. Then the internal gills also disappear and lungs are formed. Adult frogs can absorb oxygen through their skin and their lungs. The development of a frog, involving, as it does, marked changes in its form from egg to tadpole to mature frog is referred to as its metamorphosis.

Insects also undergo metamorphosis in their life cycle. The sequence in a complete insect metamorphosis is egg, larva, pupa, and adult. The body of the adult insect consists of three parts: head, thorax and abdomen. Attached to the head are two antennae; attached to the thorax are three pairs of jointed legs and usually one or two pairs of wings. There are some insects, however, which have no wings. Insects breathe by means of branched tubes that open on the sides of the abdomen.

Approaches and Concepts for the Child

Even in a city environment there are many kinds of animals. The children themselves often have an amazing variety of pets. Children learn

about animals by observing them, measuring changes in size and weight, caring for them, and reading about them. Humane treatment of all animals is practiced in the classroom. In the daily experience there is emphasis on a concern for all living things, on what Albert Schweitzer called "reverence for life". When possible, individual children or groups return animals, which had been "borrowed" for observation in the classroom, to the environment from which they came.

From the activities suggested, children learn the following.

There are many kinds of animal pets.

Animals need air, food, water, and shelter.

Some animals care for themselves; others need our help.

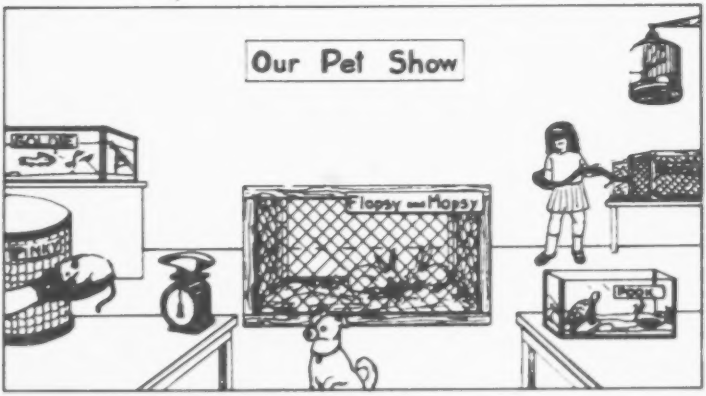
Animals swim, hop, crawl, run, or fly.

Some young animals look like the adults which they will become; others change in appearance as they develop into adults.

Some animals build their own homes.

Animals live in many kinds of places.

Animals protect themselves in different ways.



1. How do we take care of our pets?

Encourage children to bring to school, for a day or part of a day, pets that can be housed suitably, transported and handled safely. Such animals may be rabbits, canaries, parakeets, chicks, puppies, dogs, kittens, cats, guinea pigs and white rats. Schedule with the parents when pets will be brought in, perhaps a few each day for a week. For safety in handling some animals (such as hamsters), gloves should be used.

Have children describe their pets and discuss the following:

How do they move, eat, drink? What care do they need? (Exercising, keeping clean, checking on health.) What food do they eat? What homes are best for them? Why must a dog be licensed, leashed, and muzzled? How can dogs be trained?

- *We must be kind to our pets and give them good care.*
- *Each kind of pet has its own needs.*
- *All pets need air, food, water and shelter.*

2. What can we learn in school about our pets?

Children may arrange a pet show with their animals. During this period, pets should be housed suitably. Other classes may be invited to the show. Children observe these animals by feeling their skins, listening to the sounds they make, and seeing how they eat, drink and move about.

Children measure the size (length or height) and weight of selected animals and record the measurements on a large sheet of oaktag. To see if growth has taken place, the same animals should be weighed and measured again in about a month or 6 weeks. The two sets of measurements are compared and their meaning discussed. Children may watch puppies develop into grown dogs; kittens into cats. When animals are measured and weighed, children, too, may be measured and weighed.

Children devise games and riddles to identify animals by their sounds, their appearance, their locomotion.

- *We can learn many things about our pets by observing them.**
- *We can find out how fast our pets are growing by weighing and measuring them from time to time.*

3. How can we start a classroom zoo?

Children suggest the kinds of animals they can bring to school that require little care and can be kept in the classroom for an extended period of time. Such animals may be a salamander, chameleon, turtle, caterpillar, fish, tadpole, frog, toad, praying mantis, snail, beetle, ladybug, grasshopper and small non-poisonous snake. After observing the animals for a while they should be returned, if possible, to the environment from which they were taken. This is a good way of teaching children attitudes of conservation as well as humaneness.

*Statements set in italics and following bullets are understandings which may result from the activities.

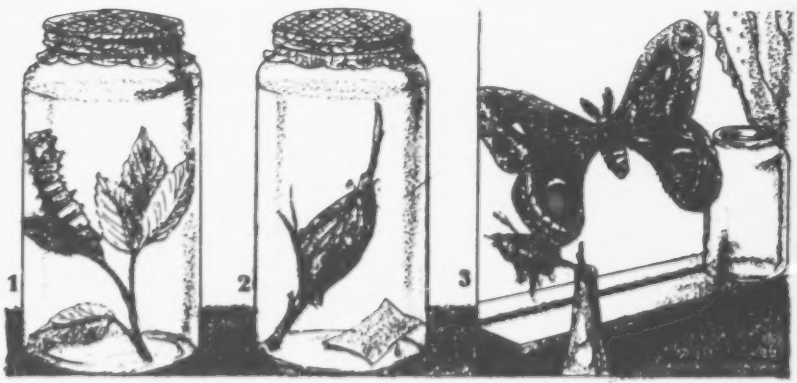
Before any animal is brought to school for a long visit, the class should plan carefully for it: build a classroom home for it, find out what food it needs, provide drinking water and adequate care over weekends and vacations. (Caution: Make sure that the child who volunteers to take an animal home has obtained the consent of his parents.)

Encourage children to bring in caterpillars, cocoons, frogs' eggs (no more than a few dozen) and tadpoles. If caterpillars are found on leaves, children should bring them in with a few of these leaves. Frogs' eggs should be brought in a jar containing water from the pond in which they were found.

- *We can start a classroom zoo by giving animals a comfortable home, the right kind of food, and enough water.*

4. What becomes of caterpillars?

Have the children place a caterpillar together with the leaves on which it was found in a jar covered with a piece of gauze. Once a week, sprinkle the twig lightly with water. Replace leaves as often as necessary. Keep this insect home in a place where children may observe it daily, noting changes that take place.



Caterpillar **Cocoon** **Moth (Cecropia)**

1. **Caterpillar with leaves it feeds on.**
2. **Cocoon in jar with moist blotter.**
3. **Moth emerging where wings can be spread and dried.**

Watch to see if the caterpillar spins a cocoon. Keep the cocoon for further study. *Note:* A moth caterpillar spins a *cocoon* from which the mature moth emerges. A butterfly caterpillar forms a *chrysalis* from which the mature butterfly emerges.

Children observe that the caterpillar moves, grows and then stops eating; and that it later spins a cocoon around itself (moth), or it changes into a chrysalis (butterfly).

- *A caterpillar eats and grows.*
- *Later it spins a cocoon or becomes a chrysalis, and is quiet.*

5. What is in a cocoon?

Put any cocoons the children bring to class into a jar or terrarium, the bottom of which is covered with sand. Moisten sand occasionally. Provide a stick or twig on which the moth can climb and dry out its wings as it emerges from its cocoon. Moths usually emerge from their cocoons at night. (*Caution:* Remove frogs and toads from terrarium because they may eat the moth.)

- *In a cocoon there is something alive which changes into a moth.*
- *A moth comes out when the cocoon breaks open.*

6. What happens to frogs' eggs?

Some children or teachers may have access to a pond where frogs are breeding. The frogs' eggs may be scooped up in a jar with water from the pond. Using a hand lens, children examine these eggs and discover that each is enclosed in a jelly-like capsule.

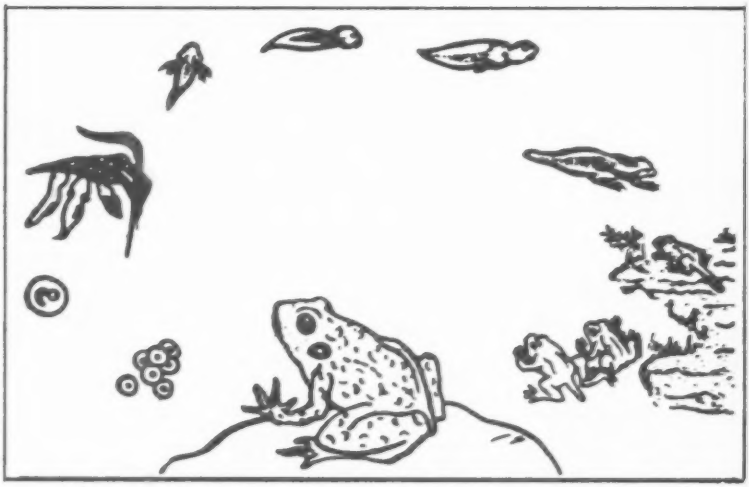
Frogs' eggs may be kept in an aquarium, a glass bowl or jar, an enamel basin or other container. Only a few dozen eggs should be kept in the container. Add a few water plants and set the container in a window where it will get sun part of the day.

Children watch the eggs change into tadpoles. *Note:* The eggs of common frogs hatch in a few to 21 days. If the egg mass turns white, the eggs are not developing.

- *Frogs' eggs turn into tadpoles.*

7. What happens to a tadpole?

Obtain some tadpoles and place them in an aquarium or large jar. Aquarium plants should be included, and pebbles, stones and rocks should be used to provide some higher, dry areas.



Some stages in the development of a frog from egg to adult.

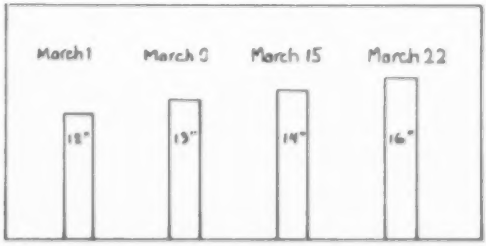
Have children watch the tadpole change into a frog. Children will note the appearance of legs and shortening of the tail. When all the legs have appeared, the water level should be lowered to give the young frog a place where it can rest with its head above water. Keep a dated record of changes (words, drawings).

Note: Tadpoles will eat fish food that falls to the bottom of the aquarium and will nibble at plant leaves and bits of raw meat and fish. Frogs require living, moving, insects or worms. If it is not possible to provide living material, it may be desirable (from a humane as well as a conservation viewpoint) to return the frogs to the original or other pond.

- *Tadpoles grow larger and change to frogs (or toads).*

EVALUATIVE ACTIVITIES

1. This paper-strip graph shows the height of a puppy on March 1, 8, 15 and 22.



a. What was the puppy's height on March 1? (12 inches.)

b. How much did it gain between March 1 and March 8? (1 inch.)

c. Between March 1 and March 22? (4 inches).

d. When did the puppy grow most quickly? (Between March 15 and March 22.)

e. How many inches did it grow at this time? (2 inches.)

2. How do children put into practice in their own homes what they have learned about correct feeding and care of their pets?

3. In classroom discussions is there a noticeable change in attitude concerning so-called "unpleasant" animals such as snakes, mice, "bugs" and worms?

4. Can the children suggest ways of measuring the growth of their pets? (String or paper strips to indicate length; marks on blackboards; using bathroom scales.)

5. If a classroom animal, such as a goldfish, dies, ask children to discuss possible causes of death. Consult "experts" (pet-shop manager, older pupils, teacher) for assistance.

6. Show children specimens or pictures of early stages of a number of animals (caterpillars, tadpoles, puppies, fish eggs, chicken eggs.) Ask what these forms will become. (Moths, frogs, dogs. fish, chickens.)

B. MORE THINGS TO DO WITH ANIMALS IN THE CLASSROOM

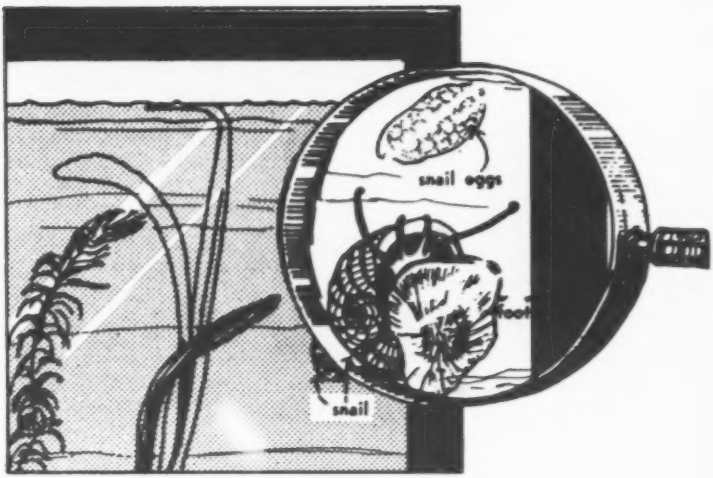
Background for the Teacher

Keeping animals in a classroom is an opportunity for teaching conservation. Children will form attitudes from what is practiced in the classroom, rather than from what is preached. The following guidelines may be useful in this connection.

Animals should be given a home which simulates as far as possible their natural environment, by use of appropriate twigs, soil, moisture, food, air, and space.

If feasible, animals taken from outdoors should be returned there when the study is over.

Animals are to be regarded as *individual*, living creatures, and not as playthings.



Ram's Horn snail and its eggs.

2. Keep some small snails in a fish tank or a large Mason jar. Fill with water and set some water plants in it. Add a small piece of lettuce or spinach leaf once a week and a bit of raw meat or fish once in a while. When the snail is on the side of the tank or jar, examine it with a magnifying glass. Notice its rough rasp-like tongue and the movement of its foot. Watch for jelly-like masses of snail eggs to appear and see what happens to the eggs.

1. Place a grasshopper in a jar partly filled with soil. The cover should be pierced to admit air. (Cheesecloth is suitable.) A peeled piece of apple will provide the necessary food.

3. Keep a few fish in an aquarium. A good rule to follow is to have about one inch of fish to one gallon of water. Do not put aggressive kinds of fish with other kinds or with smaller fish of the same kind.

4. Put a garden spider into a jar which contains a twig, a lump of soil with grass in it or growing plants. (A house spider will do. In this case a twig in the jar is sufficient.) Cover the jar with a perforated lid. Spiders will eat live insects that you drop into their webs. Watch the spiders spin a web.

5. Among other animals interesting to watch are praying mantises, ants, brine shrimp, silkworms, fireflies, salamanders, chameleons, beetles, mealworms, and ladybugs.

C. PLANTS IN THE CLASSROOM

Background for the Teacher

The time during which the seed develops into a plant with roots, stem and leaves is a crucial period. Without food, oxygen, suitable temperature, and water, the seed will fail to germinate.

The initial food supply is provided in the seed. There is enough food to last until the roots are established in the ground and the first green leaves are exposed to the sun, after which they make the food for the plant. The warmth needed for germination is supplied by the sun, which warms the soil. Water softens the hard seed coat so that the soft parts inside within may push through as they develop. The plant cells take in water, they become active, and they reproduce by cell division.

With the softening and swelling of the seed coat, the first part of the embryo breaks out. This is the part that will form the roots. Roots serve to obtain the necessary water and to anchor the plant in the soil. The soil in which plants grow must be porous to allow air to circulate down to the roots. Later, the young stem and leaves appear. The water, minerals, and carbon dioxide that the plant takes in are used in food manufacture and in building the living substance (protoplasm). The plant thrives and enlarges. The stem reaches higher and more leaves are formed. Later, flowers appear and the plant is ready for reproduction.

Approaches and Concepts for the Child

Opportunity should be provided for growing and observing many kinds of plants in the classroom (See page 244, *A "Green Thumb" in the Classroom.*) From their successes and failures in growing plants, children understand more fully the dependence of plants on appropriate conditions of light, warmth, soil, and water. In their study of plants children will find evidence that living things really do grow. They use simple graphing techniques to record the progress of plant growth.

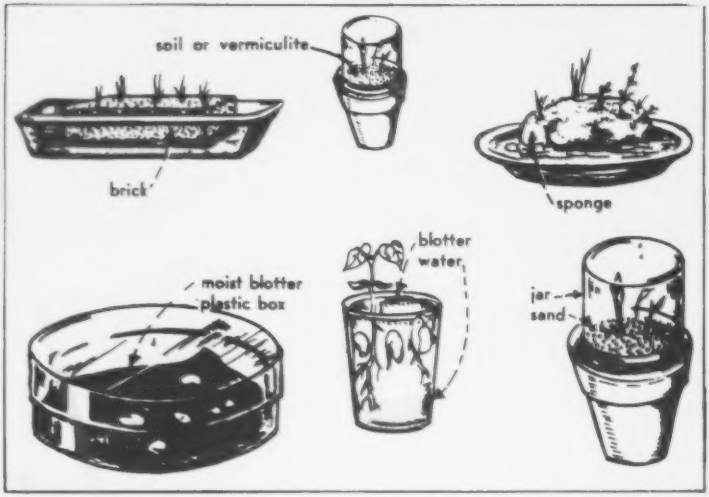
From the activities suggested, children learn the following.

Plants need water, soil, light, and proper temperature.

Plants require space in which to grow.

The common plants seen in classrooms have leaves, stems, roots, and sometimes flowers.

A seed contains a baby plant.



1. How can we make seeds sprout?

Seeds such as beans, lentils, radishes, grass seed and bird-seed may be planted to show how seeds develop into plants. Be sure the seeds are in contact with moisture but not "drowned."

As seeds sprout, children observe them daily to note changes in size of seed, splitting of seed, appearance of roots, stems and leaves. A large magnifying glass will be helpful.

- *Seeds need moisture to sprout.*
- *Seeds swell when they are kept moist.*
- *When seeds sprout, roots, stems, and leaves grow out.*

2. What changes do we see in our growing bean plants?

Children soak dry kidney beans, lima beans and other bean seeds overnight and plant them in moist soil in separate pots. They water them when necessary, watch changes, and record them periodically.

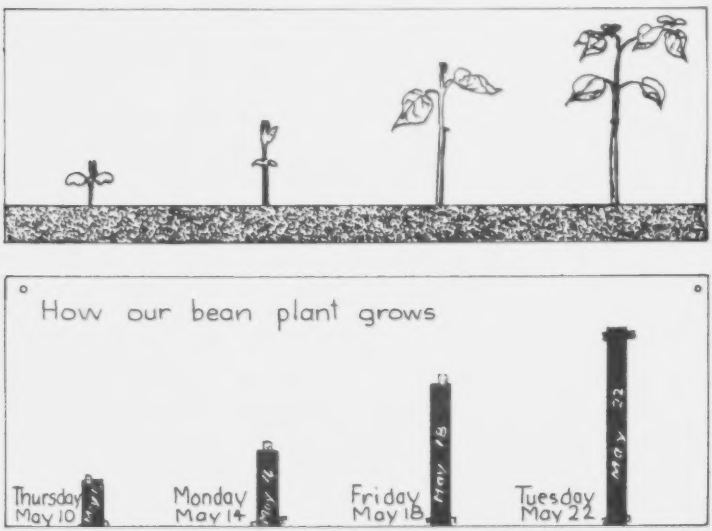
Their first observation will probably be the cracking of the soil and the mounding of the earth. Then a white, arched stem appears and straightens up. The stem grows longer, leaves appear, the old seed halves dry up and the true leaves grow larger and greener. Flowers may appear.

Ask: "Which of the plants grow most rapidly?" To answer this ques-

tion, children will see the need for some kind of record which will include the date and the height of the plant. A "paper-strip graph" is one way of recording growth. Strips of paper are cut to show the height of the plant above the soil. The graph is made by dating these strips and by pasting or stapling them to a chart on which is printed the name of the plant.

Children compare the rates of growth of various plants, as well as the color, size, shape, number of leaves, and other characteristics.

- *The baby plant is the part of the seed that grows.*
- *Part of the baby plant becomes leaves, part of it the roots and stem.*
- *The old seed halves become smaller and dry up as the plant grows.*
- *Some plants grow more quickly than others.*



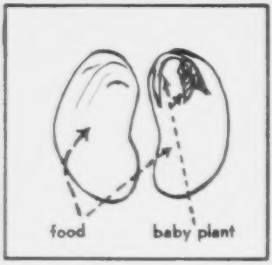
We measure our bean plant as it grows.

3. What's inside a seed?

Soak some large seeds, such as bean seeds, overnight. Each child should have one to examine. He should carefully lift off the seed coat to separate the two halves. A magnifying glass will help the child find the tiny leaves of the plant and the part that will become the root.

Discuss with the children the value of the seed coat for protecting the seed.

Ask the children to recall what happened to the seed halves in the previous activity (Problem 2). They may report that the seed halves got smaller as the plant grew larger. From this they arrive at the idea that the seed halves furnish food for growth of the baby plants.



- *A seed contains a baby plant, and a supply of food for it.*

4. What fruit seeds or vegetables can we use to make a window garden?

Carrots, beets, radishes or parsnips, seeds of citrus fruits or avocado, pineapple tops, yam or sweet potato may be used. To be sure of results, and for purposes of comparison, it is advisable to plant several of each kind. Following are instructions for planting. Have the children do as much of the actual "gardening" as possible.

CARROTS, BEETS, RADISH, AND TURNIP CUTTINGS: Remove the leaves, leaving ¼ inch of the stem; place the cuttings, stems up, in a shallow dish of water with some clean pebbles or gravel to hold them upright. Add more water as needed. Leaves will grow until the food supply in the cutting is used up.

AVOCADO (OR ALLIGATOR PEAR) SEEDS: Place in a glass or jar of water with the pointed end up, so that a third of the seed is kept wet. If the seed is small, use toothpicks as in the illustration. Keep it in a fairly dark place until white roots appear (about three to six weeks). When the main root is about one inch long place the seed in a 5-inch pot of sandy soil. Hold the seed at proper level in the pot; carefully shake sandy soil around the roots and press down gently. An alternative method is to plant the seed halfway into soil immediately after it has been removed from the avocado. Keep the soil moist.

SEEDS OF CITRUS FRUITS: Wash the seeds of grapefruit, oranges or lemons (not the "seedless" variety) and plant several in a shallow pot of garden soil. Don't water too much: once every two or three days is usually enough.

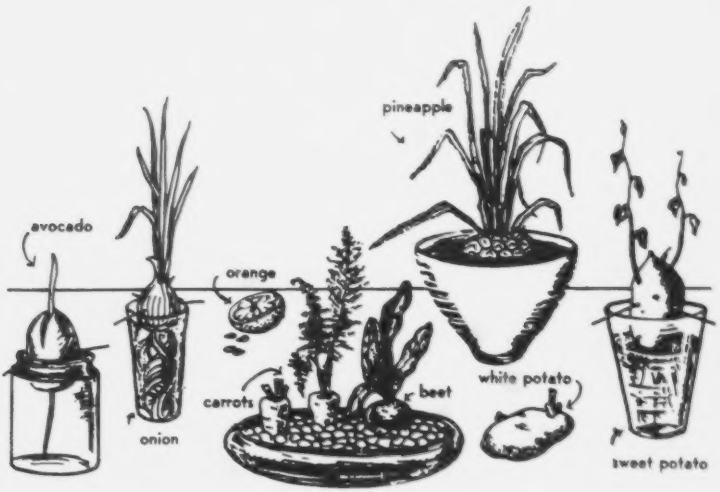
WHITE POTATO: Plant half a potato, preferably one that has begun to sprout, in a flower pot containing garden soil.

ONION: Plant in a shallow dish with pebbles, or in a flower pot with soil, or in glass of water. Keep pointed end up.

PINEAPPLE TOPS: Cut off the top inch of a pineapple. Remove the larger leaves. Put it in water, sandy soil or pebbles. Keep it moist. When roots have formed, in about three or four weeks, transplant it into a pot full of rich soil. Give this plant warmth and plenty of water.

SWEET POTATO OR YAM: Determine which part has the most dried roots (usually the narrow end). Set it with this end down in a container of water, with one-third of the potato submerged. Use toothpicks as in the illustration. Put it in a warm, dark place and add water as needed. Roots will grow first. When stems appear, put the plant near a window. (Many sweet potatoes are treated to inhibit sprouting; it may be necessary to try sweet potatoes from several sources.)

- *We grow some plants from seeds, some from other parts of plants.*
- *We can make an indoor garden with plants that we use for food.*
- *All plants need some water to grow.*



5. How can we make our plant bulbs grow?

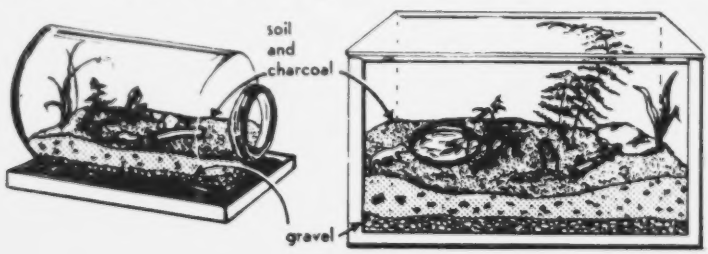
Children observe the dried roots at the base of bulbs of paper-white narcissus, hyacinth or amaryllis. They feel the texture of the skin which protects the bulb, then plant it, root end down, in pebbles, soil, sphagnum moss or vermiculite. When using pebbles, insert the bulb only as far

as the thickest part. Water as often as necessary to keep the material around the bulb moist. Keep in a cool, dark place until roots develop, then move it to a bright area.

- *Some plants grow from bulbs.*
- *The roots that grow from the bulb help hold the plant up.*
- *Water helps the bulb start growing.*
- *Some bulbs grow into plants which have flowers.*

6. How can we make a "little world" of living things?

A waterproof container with glass or clear plastic sides can serve as a terrarium, a place where plants and animals may live under conditions which simulate those found in nature. The bottom of the container should be covered with one inch of gravel. Spread humus or rich soil on top of this. Bury pieces of charcoal in these layers. Select plants which grow well in damp conditions, such as ferns and mosses. Plant them. Avoid using lichens or fungi. Rocks or pieces of bark will add to the decorative effect and supply homes for salamanders. Make a pool for animals by sinking a rust-proof dish of water into one end. Cover the terrarium with glass, allowing a small opening for air circulation.

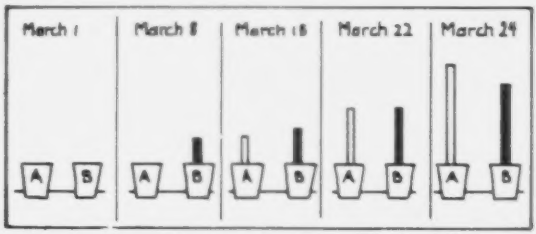


Water will condense on the inside of the glass because the air in the terrarium is more moist than the air outside. Therefore, be careful not to overwater. If much moisture collects, increase the opening at the top. A simpler terrarium can be made in a large jar by inserting a clump of turf or planting grass seed in some soil.

- *A terrarium is a "little world" where plants and animals live together.*

EVALUATIVE ACTIVITIES

1. Show children a lima bean in a dry covered dish, and a lima bean in a similar dish containing moistened cotton. Ask them which bean will sprout and why. (Beans in moistened cotton. To sprout, seeds need water.) Observe for a few days and compare results with predictions.
2. Prepare a "paper-strip graph" of an imaginary experiment with two different kinds of seeds. Ask: Which seed sprouted first? (B) Which plant grew tallest? (A) When did plant A catch up with plant B? (March 22)



3. Ask: Does soaking beans before planting make any difference in their sprouting? Do children suggest that an experiment be conducted to find out? Ask them to outline how they would set up such an experiment. (Plant 10 kidney beans which have been soaked overnight. Plant 10 unsoaked seeds in the same kind of soil. Keep under identical conditions. Observe sprouting in both groups, and measure growth of seedlings.
4. Ask: As a bean plant grows, what part of the seed becomes smaller? (The two large halves of the seed.) Why? (Because the food in them goes into the roots, stem, and leaves of the young plant.)
5. Should bulbs be started in the dark or in the light? How can we start an experiment to find out? Do children propose using a *number* of bulbs, some started in the dark and some in the light? Do they plan to keep identical conditions for both groups except for light? To make observations? To measure and keep records? What will they look for?
6. Show children a series of lima bean plants (or their pictures) at different stages of development, but not in their proper order. Ask children to arrange the plants to show the proper sequence of growth stages.

BASIC SUPPLY LIST

FOR *ANIMALS AND PLANTS IN THE CLASSROOM*

*indicates quantity for entire class; other quantities specified are for each group of 4 children.

**May be purchased from the School Garden Association of New York.

E-1: Science Supply List

- * 4 Magnifying Glasses
- * 2 Battery Jars
- Humus
- * 1 dial-type Balance
- *Aquarium Tank
- Soil
- * Terrarium with glass top
- *10 lbs. Sand
- *10 lbs. Gravel
- * 1 Bag Sphagnum Moss

G-1: General Supply List

- 2 large sheets Oaktag
- 1 pk. Cheesecloth
- 2 sheets Construction Paper
- 10 sheets Drawing Paper
- Charcoal
- 2—12" Rulers
- *2 Yardsticks
- 1 jar Paste

*Miscellaneous

- Salamander
- Chameleon
- Turtle
- Caterpillars
- Goldfish
- Tadpole
- Frog
- Toad
- Praying Mantis
- Snails
- Beetle
- Ladybug
- Grasshopper
- Small non-poisonous Snake
- Fireflies
- Garden Spiders
- Ants
- Silkworms
- 1 box of toothpicks
- Mealworms
- Brine Shrimp
- Cocoons
- Frogs' Eggs in pond water
- Aquarium Plants
- Twigs with leaves
- Rocks
- Variety of empty jars
- Fish Food
- Grass Seed
- Bird seed
- Avocado Seeds
- Grapefruit Seeds
- Orange Seeds
- Lemon Seeds
- Vermiculite
- Ferns
- Moss
- Bark of Trees
- Radish Seeds
- Assorted Fruits and Vegetables
- Cuttings of Carrots, Beets, Parsnips, Radishes and Turnips
- White Potatoes
- Onions
- Lima Beans
- Kidney Beans
- Lentils
- Pineapple tops
- Sweet Potatoes
- Yams
- **Hyacinth Bulbs
- **Narcissus Bulbs
- **Amaryllis Bulbs
- 1 shallow plastic Dish

Sunlight and Shadows

A. THE SUN IN THE SKY

Background for the Teacher

The sun is the center of a family of heavenly bodies known as the solar system. It is a star, but one of billions of stars in the sky and it is not even the largest or the brightest one. It looks larger and brighter than the other stars because it is so much closer to us. Though the sun is the closest star to earth, it is still about 93 million miles away. The diameter of the sun is about 109 times the diameter of the earth, or approximately 865,000 miles. The sun is so large that if it were a hollow basketball, more than a million earths, each the size of a pea, could be put into it.

At one time people believed that the sun rose in the east, traveled across the sky and then sank down behind the land in the west. It is now known that the sun only *seems* to do this. It is really the earth which does the moving from west to east as it turns on its axis.

Approaches and Concepts for the Child

The sun plays an important part in the daily lives of children. It determines when they awaken, when they go out to play, and when they sleep. Children feel its warmth and enjoy its light. For the teacher, the sun can be an outdoor resource available most of the time to provide learnings in science.

From the activities suggested, children learn the following.

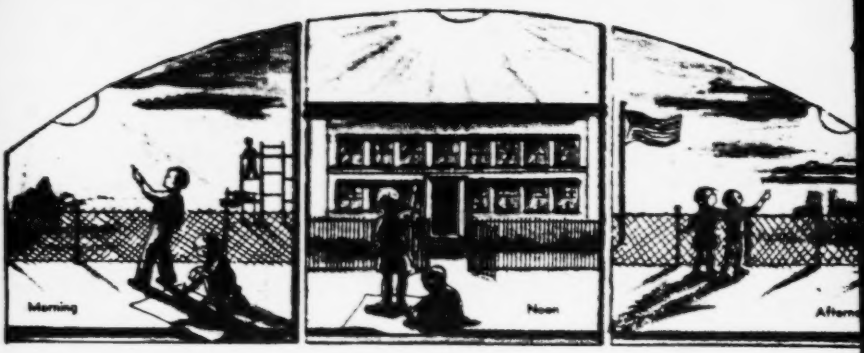
The sun is our chief source of light in the sky.

The sun is farther away than birds, airplanes and clouds.

The sun is in the sky even on cloudy days.

The sun seems to appear in different places in the sky at different times.

When the sun sets the sky darkens and night begins.



1. What makes it light in the daytime?

Children watch for sunny and cloudy days and indicate them on the calendar. They note how some drifting clouds hide the sun and also dim its light. Children observe and discuss changes they make in the classroom to adjust to the changing sunlight (seating, placement of plants and aquarium, use of shades, artificial light.)

- *The sun gives us light.*
- *Clouds sometimes get between us and the sun, and dim its light.*

2. Where is the sun?

Note: Children should be told not to look directly at the sun. Children observe the sky in the daytime. They glance quickly at the sun. They watch for birds, airplanes and clouds. They discuss which of the things they observed is nearest to the earth, which is farthest away. One way to find out is to see which obstructs the view of the other.

- *The sun is in the sky.*
- *The sun is farther away than birds, airplanes, and clouds.*

3. Where does the sun appear at different times of the day?

Children observe the sky in the morning, at noon, and at dismissal time. They point in the general direction of the sun each time and note where the sun is in relation to nearby structures. They make drawings to show the positions of the sun at the three different times of the day. These observations should be repeated on a number of occasions. Children discover that they must look in the same general direction each day to see the morning sun; this direction is called *east*. In the same way they can discover that the afternoon sun is in the *west*.

- *The sun appears in different places in the sky at different times of the day.*
- *The morning sun is in the east; the afternoon sun is in the west.*

4. What happens when the sun sets?

Suggest that the children look up at the sky around sunset and discuss the experience in school the next day. They should be guided to report on the following questions. How did the neighborhood look when the sun was low in the sky? How did the sky look? How did the sky look later, after the sun disappeared? When did the street lights come on? Did all the automobiles put on lights?

- *When the sun sets, the sky darkens and night begins.*
- *The sun is our chief source of light in the day.*

5. Where does the sunlight come into our room; into our building?

In a sunny room, the children note that different shades have to be drawn during the course of the day. They attach a paper (on which the time has been recorded) to the wall or floor where the rays of sunlight fall. They do this at regular intervals (9:00, 9:30, 10:00, etc.). They visit classes on the opposite side of the building to see where and when the sun comes into their rooms.

- *During the day, sunlight comes in different windows of our school.*

EVALUATIVE ACTIVITIES

1. Give each child a small circle of yellow paper, (representing the sun) a piece of cotton (representing clouds) a cutout of a flying bird, and a piece of green or brown paper representing the ground. Ask the children to place these four items on a piece of paper in the way in which they think they should be. If the results vary from the expected order of (a) sun on top, (b) cloud underneath, and (c) bird closest to the ground, determine the reason for this.
2. On a sunny day take children outdoors. Ask children to point toward the sun without looking at it closely. Ask the children to point to where they think it will be in late afternoon; at sunset.
3. Show children a flashlight and a piece of wax paper. Tell children that the flashlight represents the sun and the wax paper some clouds. Ask them to use these things to show why we can't see the sun on some days. (Observe light of flashlight through wax paper. Children may also shine flashlight on a dark surface and then interpose wax paper and compare.)

B. SHADOWS IN THE SUNLIGHT

Background for the Teacher

A shadow forms when a light (e.g. sunlight) is partially blocked by an object. Experiences with familiar outdoor shadows such as those made by trees, fence posts, and flagpoles, help us realize that the position of the sun in the sky determines the *length* of a shadow and the *direction* of a shadow. Consequently shadows can be used to estimate the approximate time of day.

Approaches and Concepts for the Child

The sun continues to be a source of wonder and interest to children. On sunny days children enjoy finding and playing with shadows. They are now ready to study the sun's light more closely, and with more understanding of cause and effect.

The following activities with shadows should be conducted outdoors on bright, sunny days, preferably in the early morning. For the sake of simplicity, this study of shadows should be limited to those cast on the ground, although children will undoubtedly call attention to some on various upright structures.

From the activities suggested, children learn the following.

When something comes between the sun and the earth, it makes a shadow.

The length of a shadow depends on the position of the sun.

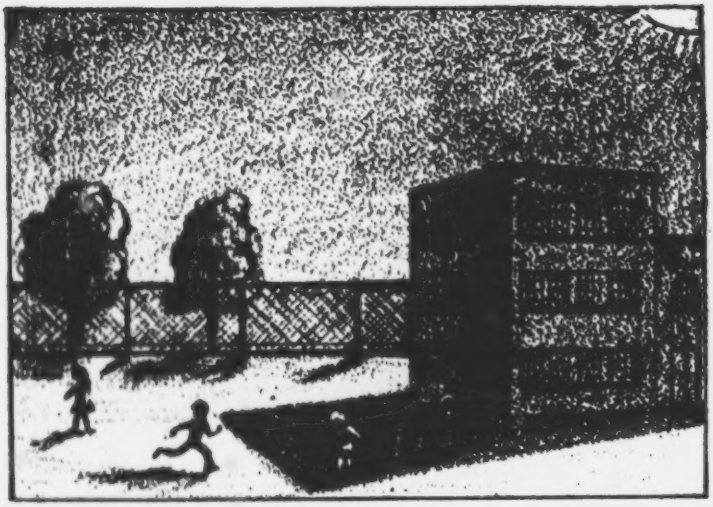
The direction of a shadow depends on the position of the sun.

Shadows can help us to tell time.

1. What casts a shadow?

Children observe the objects which cast shadows (autos, houses, trees, lampposts, people, themselves, fences.) Have one child stand in a sunny place where he can cast a shadow. Ask the other children to try to explain how the shadow is made. Does the sunlight pass through the child's body? How can you tell? How do other shadows compare with the objects which are casting them?

- *Many objects cast shadows.*
- *A shadow is cast when an object blocks sunlight.*
- *Sometimes you can tell what an object is by its shadow.*



2. Which way does your shadow fall?

Children stand in a sunny place and point in the direction that their ground shadows extend. They discover that all of their shadows go in the same direction. They find that shadows of other upright objects (fence poles, flagpoles, lampposts) also extend in this same direction on the ground. Where is the sun at this time? Children point to the sun with one hand and to the shadow with the other hand. They discover that the shadow is on one side of the object, and the sun is on the other.

- *Ground shadows in sunlight fall in the same direction.*
- *The shadow of an object always points away from the sun.*

3. What shadows move?

Children observe the shadows of moving objects: people, cars, themselves. (Some may have had the experience of observing the shadow of a cloud or airplane moving over the ground.) They note that the shadows move along with the objects that are making them.

What happens to a child's shadow when he runs into a large shadow (like one cast by a building)? He notices that his shadow disappears, and that he can no longer see the sun.

- *Moving objects cast moving shadows.*
- *Your own shadow disappears when you run into a large shadow.*
- *When your whole body is in a shadow you cannot see the sun.*

4. What do clouds do to shadows?

Children observe that shadows may become fainter and even disappear when a cloud passes between themselves and the sun.

- *Shadows may become fainter and even disappear when clouds hide the sun.*

5. How can we make pictures of our shadows?

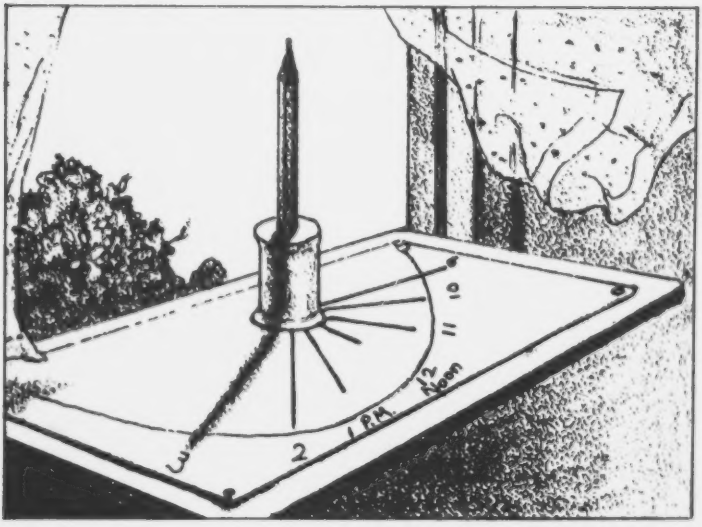
Have a child place a piece of construction paper on the ground in such a way that another child's shadow is cast on it. Have the children draw outlines of each other's shadows.

- *We can make a picture of someone's shadow by tracing it.*

6. Do shadows change during the day?

Ask the children how they can find out. They may suggest observing shadows at different times of the day. What kinds of changes do they expect will occur? (Changes in size, direction, shape, and darkness.)

How can we keep a careful record of the changes? From the previous



Using a shadow stick to measure the length and direction of shadows.

experience, children will suggest using a piece of construction paper to draw the shadow at different times.

They will find the following procedures helpful.

a. To show the varying length and direction of shadows during the day, make a shadow stick by supporting a pencil in a spool or a lump of clay. Put the shadow stick, indoors or out, where the light from the sun can strike it for a good part of the school day. Place a large piece of paper under the shadow stick base so that the shadow of the pencil can be seen on it. Beginning early and continuing every hour as long as possible, trace the shadow line in crayon. Does the length and direction of the shadow change from hour to hour? Note also the sun's position in the sky at intervals from 9:00 A.M. to 3:00 P.M.

b. At intervals between 9:00 A.M. and 3:00 P.M., note changes in shadows of posts, trees, and other vertical structures. Measure and record the length of several shadows at the observation times. How does the length of several shadows change from hour to hour during the school day?

- *Early morning and late afternoon shadows are long because the sun is low in the sky.*
- *Shadows are shortest around noon because at that time the sun is high in the sky.*
- *During the day the shadows point in different directions.*

7. Can shadows help us to tell time?

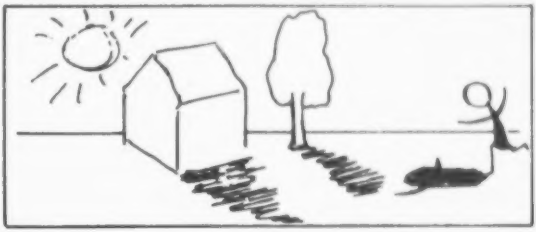
Set up a shadow stick as described in Problem 6. Place it outdoors in a sunny location, or indoors where the sun can strike it. Draw a half circle around the shadow stick, using its length as a radius. Mark the position of the shadow each hour or half-hour at the point where it touches the circumference of the circle. Label each of these points with the time the mark was made. Use this simple sundial as a clock for the next sunny school day. Place the dial in the same position it was in when you made it. Compare your sundial time with "official" time.

In what kind of weather will your sundial be unusable?

- *Shadows change in direction during the day.*
- *Morning shadows point to the west.*
- *Afternoon shadows point to the east.*
- *Shadows help us measure time.*

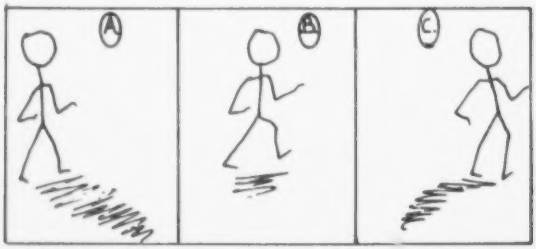
EVALUATIVE ACTIVITIES

1. What is wrong with the picture? (The shadow of the child is on the wrong side.)



2. In the picture below two things are missing in order to make the shadow of the tree. Draw these two things. (The tree and the sun.)

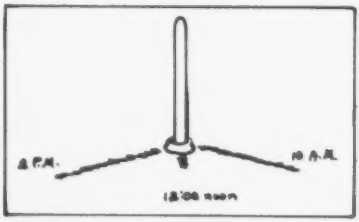
3. Which of these shadows would you expect to see at lunchtime? (B)



4. Place a large piece of news print on the ground in a sunny place such as the playground. Ask one child to serve as the "shadow-maker." Make a drawing of the child's shadow outline in the early morning. Ask children to predict what the shadow will look like at noon (lunchtime), and at three when they leave school. (At noon the shadow will be shorter and will extend toward the North; at three the shadow will be

long again but will extend in the opposite direction to the early morning shadow, that is, toward the East.) Come back at these times. With the paper and child in the same location draw the shadow outline. Compare results with predictions.

5. Show the children this drawing of a pole and its shadow at 10:00 a.m., 12:00 noon and 2:00 p.m. Ask them to draw the shadows for 11 a.m. and 1:00 p.m. (Drawings should be intermediate in length and position between the 10:00 a.m., 12:00 noon, and 2:00 p.m. shadows).



BASIC SUPPLY LIST
FOR *SUNLIGHT AND SHADOWS*

* indicates quaitity for entire class; other quantities specified are for each group of 4 children

G-1: General Supply List

4 sheets Drawing Paper
4 sheets large Construction Paper
4 Pencils
1 bar of Plasticene
1 pkg. Crayons

***Miscellaneous**

2 empty Spools

Magnets

A. USING MAGNETS

Background for the Teacher

The fact that certain kinds of iron or iron ore have the power to attract other bits of material containing iron must have been known in ancient Greece. The first known magnetic material was lodestone, which is a natural magnetic iron ore (magnetite). Lodestones are usually irregular in shape; in fact, they look like ordinary stones you might pick up anywhere. The artificial magnets that are most familiar, and which come in many shapes and sizes, are made of steel. More powerful Alnico magnets are a mixture of aluminum, nickel, iron, and cobalt.

Magnetism, like many other everyday phenomena, presents many perplexing problems to scientists. One such problem is finding out what it is that makes a magnet magnetic. In offering a tentative answer to this question, scientists point out that if a magnet is broken into halves, each half becomes a perfect magnet, with new poles forming at the break. If these halves are then broken into quarters, and so on, each new piece becomes a magnet with a north and a south pole. This leads to the theory that magnetism resides in the smallest particles of a magnet: in its atoms.

Since magnets attract things made of iron, they may be used to detect the presence of iron. But magnets also have an attraction for some other metals such as nickel and cobalt. A Canadian five-cent piece can be picked up by a magnet because of its high nickel content while an American nickel, with its lower nickel content, cannot.

Approaches and Concepts for the Child

Children are curious about magnets. They encounter a variety of magnets in toys and games, in modern kitchen appliances such as magnetic

can openers and pot holders, and in magnetic mathematics boards and bulletin boards.

From the activities suggested, children learn the following.

Magnets come in different sizes and shapes.

A lodestone is a natural magnet.

Magnets pick up objects which contain iron.

1. Where have you seen magnets?

Children find out where and why magnets are placed in such things as pot holders, mathematics boards, can openers, automobile dashboard trays, door "closers", toys, games, and other devices found in the home and school.

- *Magnets pick up some things.*
- *Magnets stick to some things.*
- *Magnets hold some things.*
- *Magnets are made in different sizes and shapes.*

2. What will a magnet pick up?

a. Have the children try bits of paper, buttons, paper clips, nails, iron and brass keys, wood, rubber, plastic, and other objects which they may suggest. They may divide these into two groups labeled *Yes* and *No*.

The common objects picked up by magnets are made of or contain iron. Children at first may say *metal,* but as they experiment they discover that not all metals are attracted by magnets. This can be a

good opportunity for children to learn to recognize iron, aluminum, copper and silver, respectively, in iron nails, aluminum pans, copper pennies, and silver coins.

b. Children examine various magnets and make drawings of such shapes as bar, U, horseshoe, cylindrical and ring. What does each type do to objects containing iron?

• *A magnet picks up things which have iron in them.*

3. Can a stone be a magnet?

Lodestone (which is on the E-1 Supply List) is a natural rock with magnetic properties. Lodestones were the first magnets, and were known for many centuries for their iron-attracting characteristics. Children experiment with a lodestone and with clips, staples or other small iron objects, and discover that the lodestone acts like a magnet. Do other stones have this property? Have children try any other stones which may be available, or which they may bring to school.

• *Lodestone is a natural magnet.*

4. When can magnets be used to separate things?

Children should have some experiences separating magnetic from non-magnetic materials.

a. Mix steel (iron-containing) paper clips with rubber bands, wooden beads, bits of paper and other non-metallic items. Use a magnet to separate the materials.

b. Mix paper clips with non-magnetic metallic items such as brass fasteners, copper pennies, pieces of copper wire, brass screws. Use a magnet to separate the materials.

c. Mix steel sewing needles with non-magnetic straight pins. Separate them with magnets. Children discover that some materials *look* similar but are made of different metals.

• *A magnet separates things which have iron in them from things which do not.*

5. How can we hunt for iron?

Have the children go on an "iron hunt" in the classroom and around the school building. What is a good iron "detector"? From their previous experiences, children will suggest that a magnet will be useful for this purpose. Give a magnet to each child and have him hold it near desks,

metal containers, radiators, basins, sinks, cabinets, playground fence, swings, flagpole. The children observe (feel, see) that the magnet is attracted to some objects, not to others.

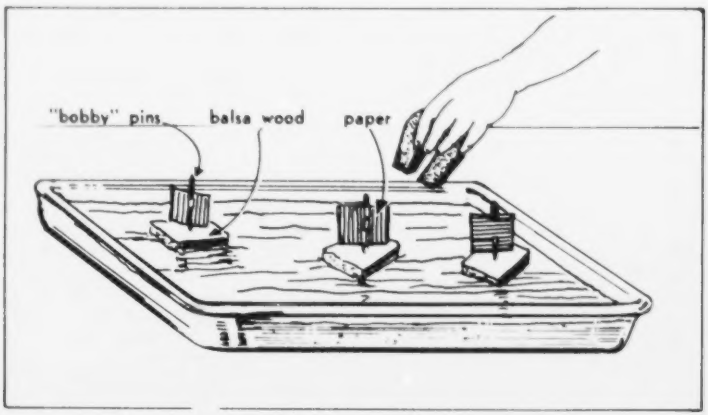
Make a picture chart to summarize the children's findings. Use two columns: *Has iron; Does not have iron.*

- *A magnet can be used to discover things with iron in them.*
- *Many things in and around the school have iron in them.*

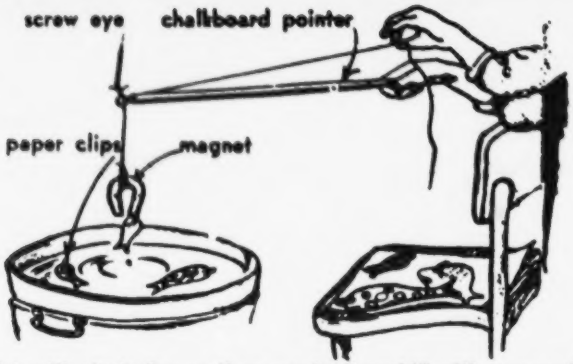
A magnet is an iron "detector".

6. What games can we play with magnets?

a. Moving a boat with a magnet.
Make a number of boats with small nails, tapestry needles, pieces of balsa wood and paper as shown in the illustration. Make the boats go by moving a magnet near them. Have a "boat race."



Toy boats with needles for masts can be maneuvered with a magnet.



Paper fish with steel clips on them can be "caught" with a magnet.

b. Fishing with a magnet.
Cut out fish from cardboard. Attach paper clips to *some* of the fish, and place all in a cardboard carton. The children go fishing, using a magnet tied to a string as their "rod". Children observe which fish are picked up. "Why couldn't you pick up the others with your 'rod'?"

c. Finding "treasures" with a magnet.
Fill a fish bowl or tank with water and drop into it various magnetic and non-magnetic objects. Use a magnet on a string to haul up the "treasures."

- *Magnets can be used for playing games with objects containing iron.*

EVALUATIVE ACTIVITIES

1. Do children report on the magnetic devices they have in their homes?
2. Show class your "catch-all" box containing thumb tacks, buttons, chalk, brass fasteners, and crayons. Ask them to suggest how to get the thumb tacks out without running the risk of sticking themselves. (Use magnet.)
3. Give each child an envelope containing the following items: paper clip, cardboard, cloth, iron nail, brass fastener, wood, thumb tack, bobby pin, aluminum foil, copper wire, plastic button. (Include some items which have not been used before.) Without using a magnet, children select and remove those items they think will be attracted to a magnet. Have them verify their answers by using a magnet.
4. Pretend to have an "accident" where you spill some paper clips into a fish tank or other glass container. Ask children to devise the quickest method to recover the clips without getting their hands wet and without

emptying the container. (Lower a magnet attached to string; run magnet on outside of container.)

5. Ask children how they would find lodestone in a box of stones. Give them an opportunity to test their answers. (Test each stone with a clip, pin or other object which they know will be picked up by a magnet.)

B. THE STRENGTH OF MAGNETS

Background for the Teacher

The ends of a magnet are called poles; each magnet has a north and south pole. Magnetism is strongest at the poles of a magnet, as can easily be discovered by applying a magnet to a pile of iron clips or tacks.

From each magnet, a magnetic influence extends out in all directions. The total influence is referred to as the magnetic field. It is in this invisible field that metals, particularly iron, are influenced. The magnetic force on an object decreases as a magnet is moved farther from that object and increases as it is moved nearer.

A magnet will act through many substances. This occurs because the invisible magnetic field extends through some materials without any or hardly any hindrance. For example, aluminum, copper, rubber, paper and glass hardly affect the magnetic influence. One might say that they are "transparent" to magnetism. Consequently, if a magnet is brought towards tacks covered by a sheet of paper, the tacks will cling to the underside of the paper. If tacks are placed in a drinking glass, they can be manipulated from the outside by a magnet.

The magnets most commonly found in the classroom are called permanent magnets. There are some magnets, however, which are temporary in nature. For example, when a permanent magnet is removed from a chain of paper clips, the clips may remain joined to each other for a short time. This occurs because each clip is magnetized. The clip chain soon falls apart, however, because the magnetism weakens.

Approaches and Concepts for the Child

As children experiment with various kinds of magnets they discover some of the properties and characteristics of magnets.

From the activities suggested, children learn the following.

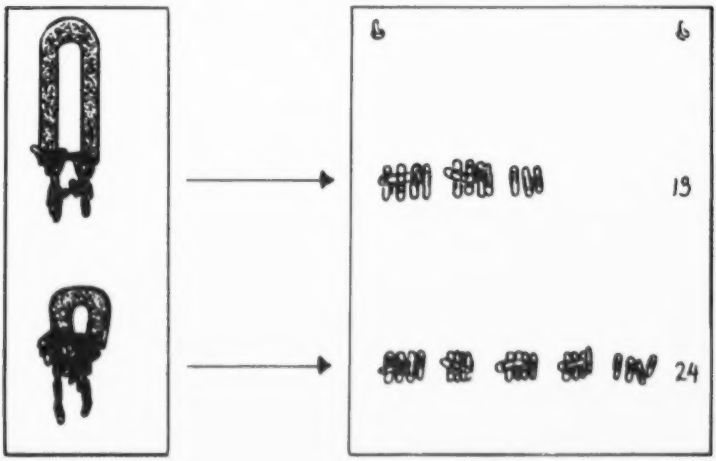
Some magnets are stronger than others.

Magnets are strongest at their ends.

Magnets can attract through many substances.

Some magnets are "permanent": they remain magnetic for months or years.

Some magnets are temporary: they remain magnetic for a few seconds or minutes.



1. How strong are the different parts of a magnet?

The children try to pick up clips, using various parts of a magnet. Have the children repeat this experiment with other magnets (bar, U, horseshoe, cylindrical). What advantage is there in a horseshoe or U shape?

- *Some parts of a magnet are stronger than others.*
- *A magnet is strongest at its ends.*

2. How can you measure the strength of a magnet?

From their experiences with magnets some children may think that a particular shape or size determines the magnetic strength. A large assortment of magnets may be used to test their theories.

Children test magnetic strength by dipping the end of each magnet into a pile of paper clips. Children may determine the strength of the magnet by counting the number of clips picked up or by placing the clips, as shown in the illustration, to make a graph.

- *Some magnets are stronger than others.*
- *You cannot guess the strength of a magnet from its shape or size.*

3. Can magnets attract through various substances?

Have the children engage in the following activities.

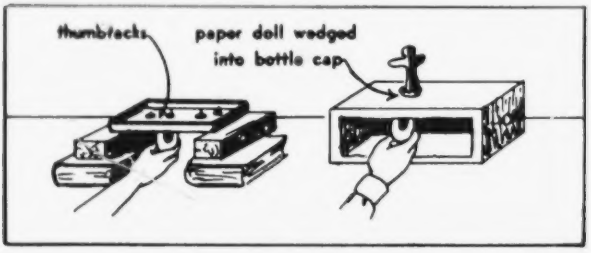
Move a magnet under a shoebox cover that has steel thumbtacks on it.

Hold a magnet to the outside of an empty drinking glass in which several clips have been placed; move the magnet around the glass.

Place paper clips in a tumbler of water; immerse a magnet near the clips. If a particular magnet fails to attract the clip, ask the children to suggest why this is so. They may say, "The magnet was not held close enough." "The glass is too thick." "The magnet is not strong enough."

Have the children test their ideas by appropriate experiments: holding the magnet closer; using a thinner glass; using different magnets.

- *Magnets can attract through some substances.*



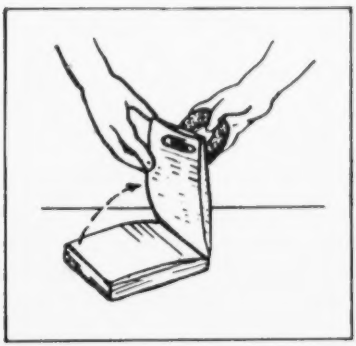
4. From how far will a magnet attract a clip?

Encourage children to speculate on the distance through which a magnet will be able to influence (move) a paper clip. They may show the distance by holding two fingers at the distance which they guess to be correct. Have the children suggest ways in which they can find out, and then let them experiment. Following is one possibility.

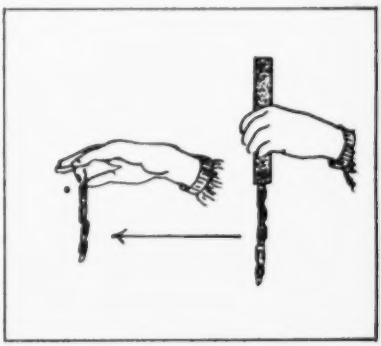
Insert a piece of paper, held vertically, between a clip and a magnet. Find out how many pieces of paper can be placed between the two before the clip falls off. Each time use the same kind of paper, held in the same manner.

With this kind of non-standard measurement it is possible for children to compare the strength of different magnets. In this way, what started out as a game may end as a method of measuring magnet strength.

- *We can measure the strength of a magnet.*



How many sheets of paper before the clip falls?



The magnet holds clips in a chain. The clips remain together for a while.

5. How long a chain of clips can you make with a magnet?

a. Have each child pick up a single clip with a magnet and then see how long a chain he can make by picking up one after another with the bottom of the end clip. How many children picked up one clip? two clips? etc., etc.

b. Encourage children to speculate about why their results differ. Their hypotheses may include such statements as, "His magnet is stronger." "The clips are different." They test these by exchanging magnets, clips, or positions.

c. Ask children *why* a clip attached to a magnet can pick up another clip. They may hypothesize that the pull of a magnet "goes through" the clip, or that the clip "becomes a magnet." Both are acceptable answers. What happens when the chain is removed from the magnet?

Children will observe that the chain holds together for a short time, and then, one by one, the clips fall off. They speculate that when the clips are not on the magnet they "lose their magnetism."

- *The pull of a magnet goes through a chain of clips.*
- *The stronger the magnet, the longer the chain.*
- *Clips stay magnetized for a time, even after the magnet is removed.*

EVALUATIVE ACTIVITIES

1. Draw a bar magnet and a horseshoe magnet. Ask the children to copy these and show, by drawing paper clips on the magnets, what would happen if each of these magnets were dipped into a box of steel clips. (Clips should be clustered at ends of magnets.)

2. In the graph below are two magnets and the clips each picked up.
   a) How many paper clips can magnet "A" pick up? (16)
   b) How many paper clips can magnet "B" pick up? (7)
   c) Which magnet is stronger, "A" or "B"? ("A")

3. Show children that a certain magnet does not attract a paper clip through a magazine that is about one quarter-inch thick. Ask the children to suggest possible reasons why the clip was not attracted to the magnet. Have them set up experiments to test their ideas. For example: Is the magnet too weak? (Try a stronger magnet.) Is the paper too thick? (Try a thinner magazine.) Is the clip too heavy? (Try a lighter clip.) Is the clip made of something which is not attracted to a magnet? (Try it with a magnet acting directly on it.)

4. On a flat ceramic dish place a flat paper doll to which a paper clip has been fastened. Shift the paper doll by moving a strong magnet under the dish. Make sure the children do not see the magnet or the clip. Ask the children what they think is moving the doll.

C. HOW MAGNETS AFFECT OTHER MAGNETS

Background for the Teacher

If a bar magnet is suspended in a horizontal position by a string, it will come to rest pointing north and south. The end of the magnet that points to the north is called the north pole of the magnet; the other end is called the south pole.

If the north pole of another magnet is now brought close to the north pole of the suspended one, the latter will swing sharply away. On the other hand, if the north pole is brought close to the south pole, the attraction will pull the suspended magnet to the other one. In short, like poles repel and unlike poles attract.

Approaches and Concepts for the Child

Most of the explorations with magnets have been related to the use of one magnet at a time. Experiments with two magnets, however, reveal the attraction and repulsion that exists between magnetic poles.

In this grade, although we do not develop the concept of *north* and *south* poles, we do encourage children to discover that when two magnets are brought together their ends (or poles) attract and repel each other, depending on how the magnets are held.

From the activities suggested, children learn the following.

When two magnets are brought near each other, they pull together or push apart.

A magnet can push or pull another magnet without touching it.

1. What happens when two magnets are brought near each other?

Distribute a pair of magnets to each child (or group). Encourage children to experiment and to tell of their findings: what they feel, what they see, what they hear.

- *When two magnets are brought near each other they pull together or push apart.*

2. Can one magnet make another one roll?

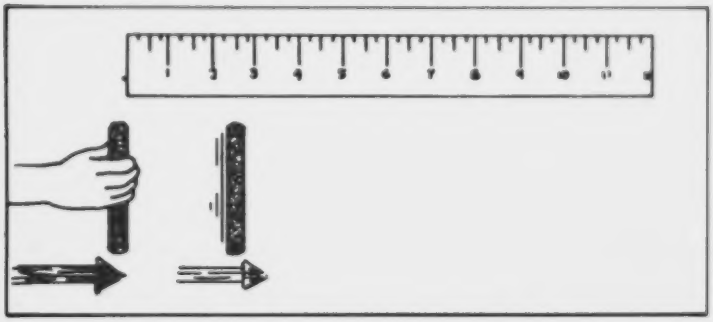
a. Children experiment with a pair of cylindrical magnets to find out how one magnet can move the second one without touching it. They

"They're pushing each other apart!"

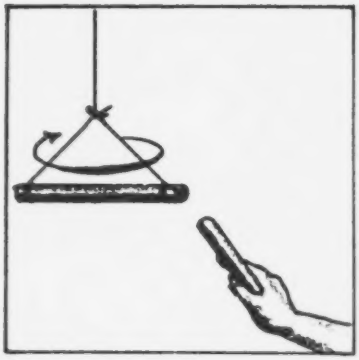
do this by placing one of the magnets on a table and holding the second one parallel to the first. They observe what happens when the magnet in the hand is brought near the one on the table. If the two magnets attract each other, what must be done? (Turn one of them over.)

b. How close to another can your magnet get before the other one starts moving? Children may use a ruler, a strip of paper or any other method to measure the distance.

• *One magnet can make another roll without touching it.*



Measuring the distance between two rolling magnets.



3. Can one magnet make another one spin?

How can we find out? One way is to suspend a magnet by a string and use another magnet to make it turn around. Children will find that they can accomplish this by manipulating the magnet in their hand in different ways.

- *One magnet can make another one spin.*

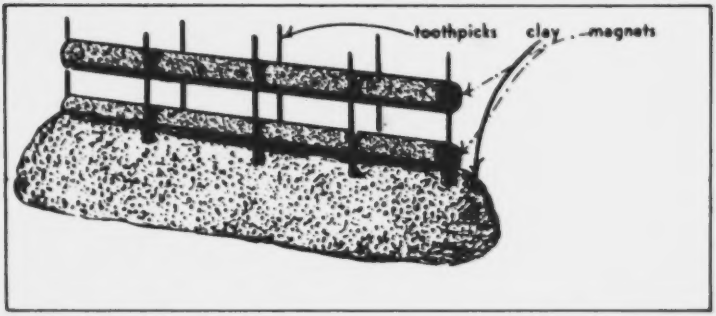
4. Can one magnet make another one stay up in the air?

Children experiment with two magnets (strong bar or cylindrical magnets) held in their hands, one above the other. From their earlier experiences they have found that when magnets are held in a certain position they repel each other, or, as they may say, "push away." They may try to apply this idea to the present problem by holding a magnet firmly in one hand, and then lowering the second one over the first and letting go. They will find that the upper magnet will twist around into the "pulling-together" position, and join the lower magnet. The problem is, then, how can the upper magnet be prevented from twisting?

The illustration shows one way of doing this. Eight toothpicks are pushed into a piece of modeling clay to make a "fence" around the lower magnet. The children are amazed to find that in one position, the upper magnet is suspended in the air.

Ask the children why this happened. In various ways they will say that magnets can push against each other, even through a distance. The push may be strong enough to hold up one of the magnets.

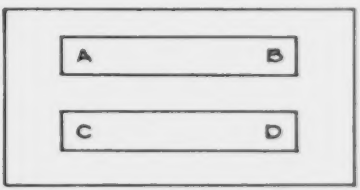
- *Magnets can push against each other, even when they do not touch.*
- *One magnet can make another one stay up.*



One magnet makes another one stay up.

EVALUATIVE ACTIVITIES

1. Attach a bar or cylindrical magnet to a "raft" made of a flat piece of wood. Place in a large pan (not made of iron) or tank of water. From what the children have learned before, see if they can make the raft come toward them, away from them, or even turn itself around by means of another magnet held in the hands of a child. (Turn or move the magnet in their hands.)
2. Show children a drawing of two magnets, each marked as shown. Tell them that pole A is attracted to pole D. What will happen if poles A and C are brought near each other? (They will repel.) If B and D are brought near each other? (They will repel.) If B and C are brought near each other? (They will attract.)



BASIC SUPPLY LIST
FOR *MAGNETS*

* indicates quantity for entire class; other quantities specified are for each group of 4 children

E-1: Science Supply List

- 2 Bar Magnets
- 4 Cylindrical Magnets
- 2 Ring Magnets
- 2 Horseshoe Magnets
- 2 U-shaped Magnets
- 2 Lodestones
- 2 Balloons
- 2—6" strips copper Wire
- *1 Fish Tank

G-1: General Supply List

- *1 box of Nails
- *1 box of Paper Clips
- *1 pkg. Tapestry Needles
- 2 Erasers
- 10 Rubber Bands
- 1 row of non-mag-magnetic Straight Pins
- *1 box Brass Fasteners
- 1 doz. Brass Screws
- 2" x 2" Balsa Wood
- 2 sheets of Oaktag (8½ x 14)
- 2 pairs of Scissors
- 2 sheets of colored Construction Paper
- *1 box of Thumbtacks
- 1 glass or plastic Tumbler
- 2 sheets of lined Composition Paper
- 1 bar of Plasticene
- 2—12" Rulers
- *1pkg. Wooden Beads
- 1 row of Staples
- *1 ball of String (warp-thread-white)

***Miscellaneous**

- Shoe Boxes
- 2 Aluminum Pie Plates
- Iron Objects (keys)
- Various Buttons
- Small Plastic Objects
- Small Wooden Objects
- 2 ten-cent Coins
- Copper Pennies
- Small magnetic House-Hold Devices
- Magnetic Toys and Games
- 2 doz. Toothpicks

Water, Soil, Rocks, and Air

A. WATER AROUND US

Background for the Teacher

Water is a most important material for plant and animal life. Most living things contain more water than any other substance.

Water has many forms. As a liquid, water flows and pours; as a gas (water vapor), it moves freely but cannot be seen; and as a solid (ice), it is hard, still, and brittle.

Approximately *70 per cent* of the earth's surface is covered with water. The *availability* of water is an important factor in determining the types of plants and animals that are found in a community. The water supply for many cities comes from nearby lakes and rivers, or may be conducted to the city by viaducts from distant places.

Towns and cities generally supply their communities with water from reservoirs, through an underground system of large mains. These very large mains subdivide so that a smaller main runs down each street. A house main branches off from a street main, coming into the house through the cellar wall. In our latitude, water pipes outside a house are buried in the earth below the frost line, so that they will not burst from water freezing in them.

Dirty water goes through a waste pipe and out of the house into a large sewage pipe. If there is no sewage system in the community, the sewage from the house empties into septic tanks or cesspools, where bacterial action converts the wastes into harmless substances. City-sewage disposal plants often work much the same way as a septic tank, but on a larger scale.

Approaches and Concepts for the Child

Experiences with water are appealing to children. They use water for bathing, drinking, watering plants, mixing beverages, and playing.

Through their curiosity and their explorations, they develop some insight into the nature of water. They are interested in finding answers to such questions as the following.

"How does the water get into our building?"

"Why does water in the fountain come up?"

"Where does water go when it leaves the sink?"

"What things disappear in water?"

Other experiences with water are described in the science problems in the area of *Weather*, and in the publication *Operation New York*, available in each school.

From the activities suggested, children learn the following.

Water has the shape of the container it is in.

Water flows more freely through some objects than it does through others.

Water has many uses.

Water runs downhill.

Water can be forced to go up.

When different substances are mixed with water, they may disappear (dissolve), sink or float.

Stirring helps some things dissolve faster in water.

Some substances color water.

1. What will hold water?

Have some children put water in the palms of their hands over a sink or basin. What happens to the water? Ask the children to think of a better way of holding water. They may suggest using various kinds of containers, such as bottles, jars, cups, and glasses. Help them extend their list to include containers made of substances other than glass, such as plastic, waxed paper, metal. Make a collection of as many containers as possible for this and other problems in *Water Around Us*.

Try out some of these and compare their water-holding qualities with that of their hands. Does water leak through any of these containers? What else makes a container suitable for holding water? Shape, size, ease in filling and in emptying are some of the other characteristics which may be mentioned.

- *It is hard to hold water in your hand because the water runs out of it.*
- *Many different materials can be used for containers to hold water.*
- *A good container for water is easily filled, easily emptied, does not leak, and holds enough water for its job.*

2. What kinds of utensils allow water to pass through them?

Gather an assortment of sieves, strainers, colanders, watering cans (with perforated heads), and clothes sprinklers, all of which have holes in them to allow water to go through. Have children inspect and try out these utensils.

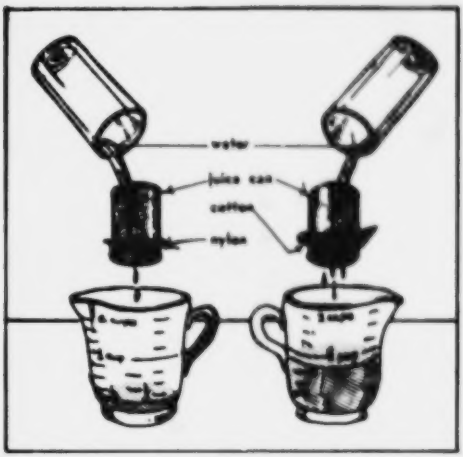
Discuss why these utensils are useful. The holes of a colander allow water to go through it but are small enough to prevent food (spaghetti, for example) from going through. The holes of a watering can "break up" the water into many thin streams which sprinkle the water gently over the soil.

- *Some utensils have holes in them to let water go through.*

3. What kinds of materials can water go through easily?

This discussion may be initiated by noting the kinds of clothing worn on rainy days. Rainwear must keep water out to protect the skin and inner clothing of the wearers.

Encourage children to suggest (by name, or other means of identification) various materials such as nylon, rayon, cotton, plastic, and rubber, which they think may allow water to pass through easily, or which they think may shed water. How can we find out? Encourage children to



Water goes through	
cotton	fast
nylon	not so fast
plastic	not at all
leather	
rubber	

Measuring helps us compare accurately.

suggest methods. A can from which both ends have been removed, and a basin to catch water may serve as the testing device. Stretch the material to be tested across the bottom of the can, hold over the basin, and pour a glass of water into the top of the can. What happens? Does water go through quickly, slowly, or not at all? Test each of the materials and summarize findings on a chart.

Children may find it difficult to determine whether the water goes through one material faster or slower than it does through another. This is an excellent opportunity for developing the idea of measurement. Ask children how we can be more certain of the time it takes. One method of deciding between two materials may be to compare the results of two tests run at the same time. Other methods that some may suggest may require a watch with a second hand, a stopwatch, a metronome, or rhythmic counting by the class.

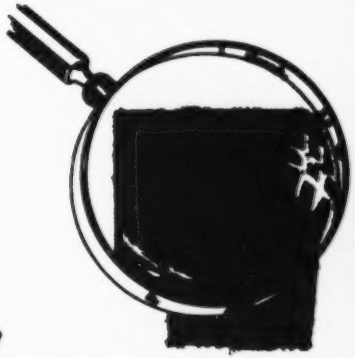
- *Water flows more quickly through some materials than others.*
- *Some materials do not allow any water to pass through.*

4. How can water get through a material?

Have children inspect the materials through which water flows. If they hold them up to the light they may detect holes in these materials. Compare these with rubber, plastic, and waterproofed materials.

A magnifying glass will enable children to see holes in materials more easily.

- *There are holes in materials which allow water to go through them.*

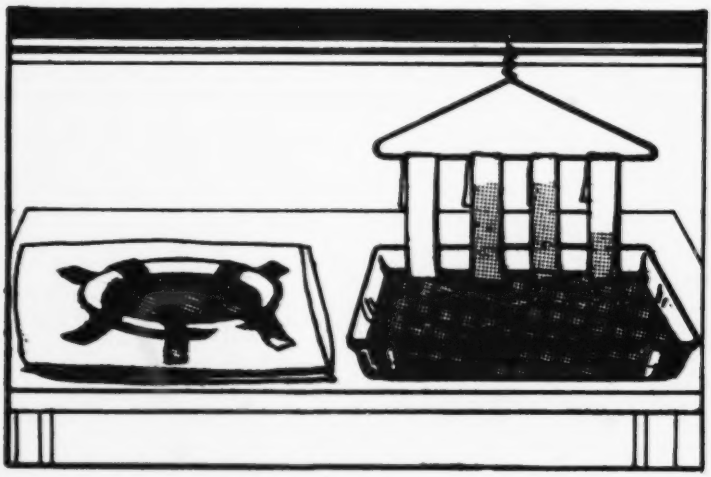


5. What materials soak up water?

Children recall that some materials soak up water readily, while others do not. How can we find out which material soaks up water? Let children suggest the materials to be tested. These may include such materials as blotters, wax paper, aluminum foil, plastic, cotton, and nylon.

How can we test the water-soaking capacity of the materials? Again let children propose methods. One method may be to cut strips of equal length, and place them so that one end of each is immersed in a dish of water, as shown in the illustration. The other end hangs over the dish. What happens? Which materials soak up the water most rapidly? Are they materials with holes (porous materials) or those without?

Another method of conducting a "soak test" is to suspend the strips



Two ways of comparing the amount of water soaked up by different materials.

from a wire clothes hanger so that the lower end of each strip is immersed in water. Compare the results.

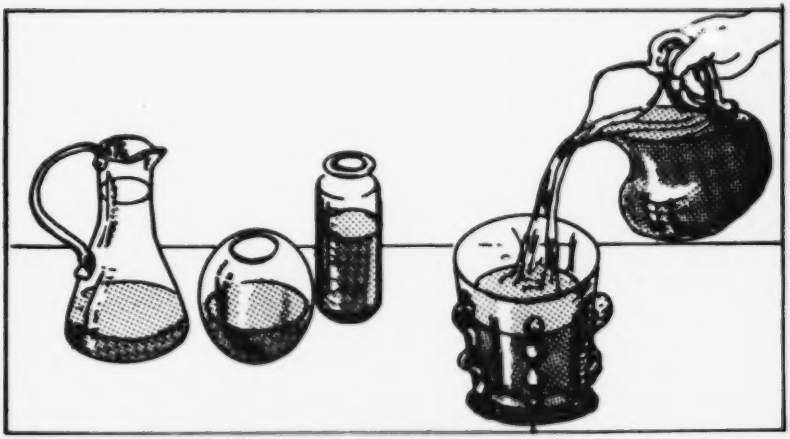
Children use the magnifying glass again to discover that the porous materials contain openings which can hold water. Such openings will not be visible in the non-porous group. Materials such as rubber and plastics used in the manufacture of rain garments have practically no pores or holes. Other materials such as wax paper have had the holes filled. In either case, water cannot enter the material.

- *Water soaks into some materials, but not into others.*
- *Materials that soak up water have holes in them.*

6. What is the shape of water?

Children may regard this as a strange question. Ask them to pour water into containers of various shapes and then try to answer the question. They will see that water takes on the shape of the container it is in. They may use such words as round, thin, curvy, deep, long, to describe water's shape in various containers. They experiment by pouring water from one container to another, and they see how its shape changes. Ask, What else changes shape easily? (Milk, orange juice—any liquid.)

What shape do things other than water take when they are placed in containers? Encourage children to suggest items such as small blocks, wooden beads, sugar, salt, flour, marbles, and sand. Compare with water. Children note that some of the larger objects (blocks, beads, marbles) have spaces between them. The larger objects do not take the shape



Water takes the shape of its container.

(fill the space) of the container as well as materials made of small particles, such as sugar, salt, flour and sand.

- *Water takes the shape of the container.*
- *Water changes its shape easily because it flows.*
- *Solids made of small pieces also take the shape of the container.*

7. How do different things mix with water?

Stir small amounts of such substances as sawdust, salt, and sand into separate containers of water. What happens to each? Do any of them seem to disappear? Does stirring help?

- *When some things are mixed with water, they go to the bottom.*
- *When some things are mixed with water, they float to the top.*
- *When some things are mixed with water, they seem to disappear.*

8. What is a good way to color water?

Allow children to experiment with small amounts of vegetable dyes, ink and watercolors. Observe how color creeps slowly through the solution when it is not stirred with a spoon.

- *When some things are mixed with water, they color the water.*
- *A little coloring can color a large amount of water.*
- *Stirring helps spread the color faster.*

9. How can water be moved from one place to another?

Note: The following experiences should be divided into several lessons. A number of large basins or deep pans are appropriate for this activity.

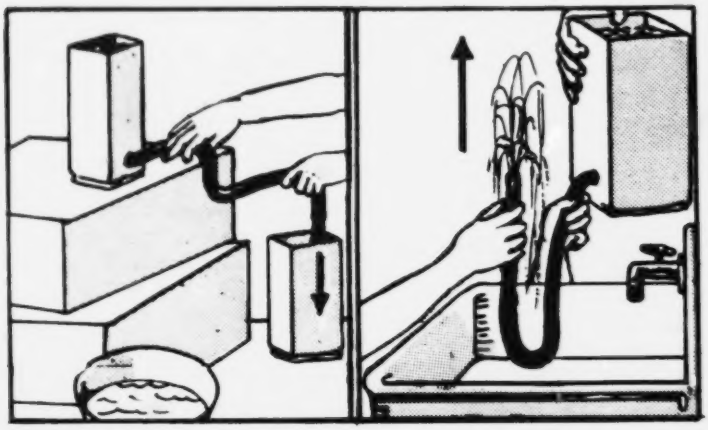
Collect such materials as cups, small cans, a kettle, a watering can with a long spout, a pitcher, clean milk cartons, funnels of different sizes, lengths of plastic or rubber tubing, a rubber bulb with a perforated nozzle (clothes sprinkler) and atomizers.

a. Children move water from one container to another by pouring it. They may discover that is more difficult to pour from a wide-mouthed container than from a narrow one. Use utensils such as pitchers, funnels, kettles and watering cans from which water can be poured without splashing or spilling. Children may wish to make their own funnels and experiment further.

b. Guide children to find out that water can be moved by spraying from some form of atomizer. An atomizer pumps water out as droplets (not atoms).

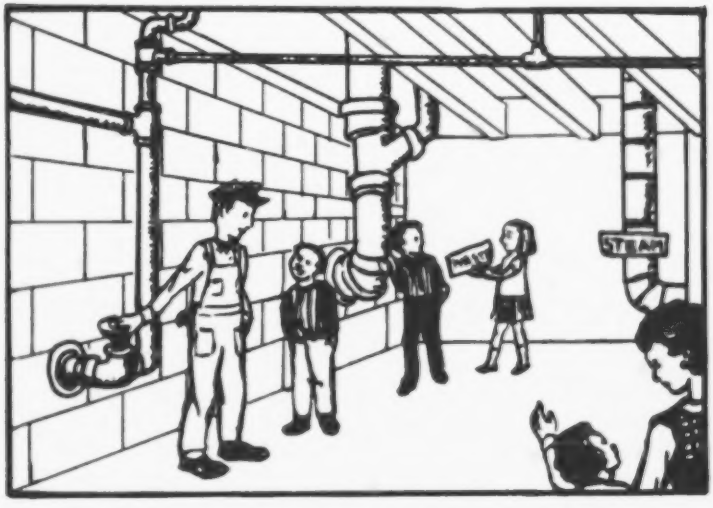
c. Children experiment with water and rubber tubing, pans and other containers. They learn how water can move from one milk container to another. They make a "fountain" by connecting one end of a rubber tube to a milk container full of water, and holding the other end up as shown in the illustration. Which way does the water move out of the tube? How can we stop the water from flowing out of the tube? (Lower the container.)

- *Water can be moved by pouring.*
- *Funnels and narrow-mouthed containers aid us in pouring water.*
- *Water can be moved by spraying it.*



Water goes down. **Water goes up.**

- *Water can be moved through pipes.*
- *Water flows from high places to low places.*
- *Water falls to the lowest level it can reach.*
- *Water can be forced up.*



Finding out where water enters and leaves the building.

10. Where does water in the faucet come from?

Plan a water "hunt" in the school to find out where water is used and what it is used for. Explore pipes and faucets in different parts of the building. Can you find the water pipes leading to the bubble fountains in the corridors? Ask your custodian to show you the water pipes coming into the building in the basement. Some pipes have a covering that keeps the water hot. Let the children put their ears to a cool pipe to hear the water flowing. Visit a street excavation. Ask the men at work to point out the water mains.

- *Water is found in many places in our school.*
- *Water has many uses.*
- *Water in the faucet comes from pipes.*
- *Water comes into our building from large pipes under the street.*

11. Where does water go when it leaves the sink?

Ask a child to turn on the faucet. Allow the sink to fill up with water. Then let it drain. Ask the children to point to where the water goes. Look under the sink to trace the drain pipes. Have the children note the strainer covering the sink outlet. Discuss why it is there. Note the size of the holes. What kinds of things does the strainer keep out of the drain pipe?

Ask your custodian to show you the sewer pipes which carry water out of the building. Visit a street excavation to see a sewer pipe.

- *Water in a sink goes down a drain.*
- *Drain pipes lead waste from sinks and toilets to larger pipes that go out of the building.*
- *The waste pipes in the building connect to larger sewer pipes under the street.*

EVALUATIVE ACTIVITIES

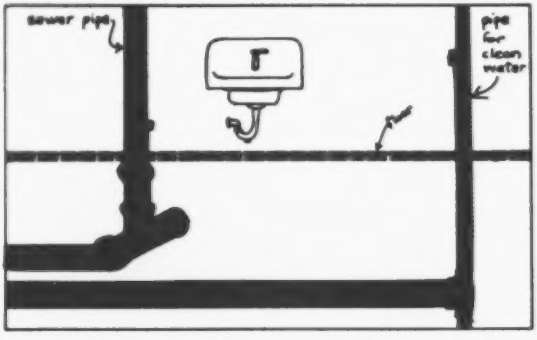
1. Can children predict which materials, other than those used in class activities absorb water best? Arrange a "race" to find out who can mop up most quickly a given (measured) quantity of water from a surface. Children may select from a variety of expendable or old materials which the teacher makes available for this purpose. Examples: an old woolen glove, a leather glove, different types of glazed and unglazed paper, sawdust obtained from the custodian.

2. Are the children learning how to conduct an experiment related to this topic? Prepare a bowl of water which can hold a cube-shaped block. Have available a cube of wood and cube-shaped sponge which is of the same approximate volume. Ask the children which of the two objects will soak in more water. After they have made a prediction, ask the group how this can be measured. Elicit, if possible, that lines may be marked (or paper taped) on the side of the bowl to indicate how much water is left when the wooden block is removed as compared to the amount left when the sponge is removed. Some children may suggest collecting and comparing the water which may be extracted from the wood and the sponge cubes, by shaking and squeezing them into a glass.

3. Take the class on a short walk to see whether the children can recognize water-resistant materials other than those discussed in class. These materials may include metals, concrete, plastic awnings, painted surfaces, glass, asbestos shingle, and asphalt. How do these materials serve as protection against water?

4. See whether children can devise an experiment to find out how long a paper cup will hold water before it starts to ooze. (Hint: A sheet of newspaper, paper towel, any unglazed paper or a tray under the cup will reveal water if leakage occurs.) Try different kinds of cups. Which holds water best?

5. After a trip to find out how water comes to a faucet and how used water gets to the sewer, prepare a rexographed diagram showing only the water main, the sink and sewer line. Are children able to draw the connecting pipes from main to faucet and from sink drain to sewer?



6. Are children aware of the different ways in which water may be conserved? Prepare a demonstration of "wasted water" by making a small hole in a large paper cup or can. Fill with water and see how quickly this water is lost into a larger container. Ask the children to note the different ways that water is lost. Make a chart that includes unattended running water, leaky faucets, overuse of water in washing dishes, and deliberate running of water to get a cold drink. In each instance ask the children how water could be saved.

7. See whether children can suggest how dried-up tempera paint can be made usable again. Have them try their suggestions.

8. Ask children whether they can convert a water-absorbing material like paper or cloth into a water-repellent material. Hint: (a) Drip the wax of a candle over the paper or cloth. (b) Dip it into oil. How can we test it? (Put several drops of water on it and see what happens.)

9. Test whether children can improvise methods of pouring water from wide-mouthed containers to narrow ones. Examples: from classroom basin through the opening of a small milk container; from a saucer to a narrow-mouthed plastic medicine vial. (Methods may include making a V-shaped trough from a cardboard or an aluminum pie-plate: punching a hole in a paper cup.)

B. SOIL AROUND US

Background for the Teacher

Soil is formed in part by the breakdown of rock and in part from the decay of plants and animals. The constant decomposition of rock and of animal and plant material releases valuable minerals into the soil.

Soil contains many living organisms: worms, bacteria, molds, microscopic animals (protozoa) and others. The activities of these organisms, and their interrelationships, determines many of the characteristics of any particular soil, including its usefulness for cultivation of particular crops.

The topsoil is the layer of soil usually cultivated for crops. In the United States the average depth of topsoil is 9 inches. Topsoil, like the subsoil underneath it, contains sand, silt and clay. Topsoil, however, is much richer in humus—the organic material from decayed plant and animal wastes. Topsoil contains the valuable minerals needed for plant growth. This layer is easily penetrated by the essential air and water. Much of our valuable topsoil has been either blown away by wind or washed away by water. When the topsoil is swept away, it cannot be re-formed naturally within the lifetime of a man!

Plants help in soil conservation because their roots prevent soil from being washed away. Plants also cover and protect the soil from wind.

Approaches and Concepts for the Child

In a city environment, children do not always have sufficient opportunity for firsthand experiences with soil. The school can provide such experiences by the use of the school garden, by having children prepare soil for classroom flower pots and window boxes, and by planning for trips to nearby gardens and parks. See also, *Operation New York* (available in each school).

From the activities suggested, children learn the following.

Soil is found in many places in our neighborhood.
Water and wind can carry soil away.
Moist soil holds together better than dry soil.
Different kinds of soils have different colors.
Soil has many things in it. Some are living, some are not.

1. Where can we find soil in our neighborhood?

The children will offer clues. Take a trip to find soil around the street

trees, in florist shops, in school and home gardens, in excavations, in nearby parks. What is growing in the soil?

- *Soil is found in many places in our neighborhood.*
- *Soil is used for growing plants.*

2. What is in the soil?

Magnification helps us see what is in the soil.

Ask the children to bring in envelopes of soil. Observe the different colors of the soil. Spread the soil and look for the following: small pebbles, grains of sand, bits of leaves, small pieces of wood, seeds, worms, ants, and other living things.

Place some of the soil in an empty jar, aquarium, pot, or window box. Water regularly. Look for the appearance of new plant and animal life.

- *Different soils have different colors.*
- *Soil has many different things in it.*
- *Some of these things are living, some are not.*

3. How can we get the pebbles out of soil?

This question may arise when children are preparing soil for planting. Sift a sample of garden soil through a coarse strainer or piece of Dixie mesh. Compare the soil which goes through the strainer or mesh with the unsifted soil. Pick out and examine the pebbles and other fragments which are caught by the strainer or mesh. Use a magnifying glass to extend observations.

- *Sifting the soil is one way of breaking it into small pieces.*
- *Garden soil may have pebbles in it.*
- *Sifting the soil takes the pebbles out of it.*

4. What does water do to soil?

Ask the children to look at dry soil in a window box or flower pot. Let them feel its weight and texture. Spread some on a piece of paper.

Add some water to the soil in the flower pot. Encourage the children to handle the moist soil. Spread some of the wet soil on a piece of paper. Compare the color, texture, and weight of moist and dry soil.

Fan some dry soil with a cardboard. Note how it is blown about. Compare the results with that obtained by fanning moist soil.

Take a walk after a heavy rain. What has water done to soil around trees, on lawns, and on bare hillsides?

- *Moist soil sticks together better than dry soil.*
- *Moist soil is not blown around as easily as dry soil.*
- *Running water can move soil.*
- *Moist soil looks darker than dry soil.*
- *Soil sometimes cracks as it dries.*

EVALUATIVE ACTIVITIES

1. Are children using the world "soil" rather than the word "dirt" in their class discussions?
2. During a trip in the neighborhood, do the children notice moist soil, dry soil, the presence of gullies, and eroded areas?
3. Prepare two samples of soil, one containing much more sand than the other. Can children recognize the differences in the samples as a result of their own examinations (seeing and feeling)?
4. Can the children find live animals, live plants, dead animals and plants, and bits of rocks in a sample of soil?
5. Ask the children whether all the soils they have seen or examined are the same. How can we find out? Bring in soil from an empty lot, from a garden, and from the florist shop. Keep track of the respective samples by means of appropriate labels. Do all the soils soak up water the same way? Do all the soils have the same color? Will each of the soils help seeds to grow equally well? How can we find out?
6. Can a seed grow as well in sand as it can in soil? See whether the children can devise an experiment that will help them answer this question. (Plant a few seeds in a flower pot of sand and others of the same type in a similar flower pot of soil. Label the flower pots appropriately. Give equal sunlight and water. Observe the results.)
7. Make a pile of soil in the shape of a small mountain. (Use a large pan or tray for the purpose of good housekeeping.) What will happen to the soil if water is sprinkled on it? Can the children predict which way the water will flow?
8. Do the children understand how sand and rocks become part of the soil? Have the children put rocks into a plastic jar or metal container. Place water in the container and shake. Remove the large rocks and children will observe the small particles that have broken off the rocks.

C. ROCKS AROUND US

Background for the Teacher

The rocks of the earth's crust may be divided into three large groups, according to the way in which they were formed: igneous rocks, sedimentary rocks, and metamorphic rocks.

Igneous rocks are those which were formed as a result of cooling and hardening of hot molten rock (magma) from within the earth's crust.

Volcanoes are a source of igneous rock. Some examples of igneous rocks are obsidian, pumice and granite.

Obsidian (sometimes called volcanic glass) results from the rapid cooling of surface lava. It was once used to make arrowheads and knives. Pumice, used in many scouring powders, contains holes which were formed by escaping gases while the rock was still liquid. Some pumice is so light it will float on water. Granite is recognized by its speckled appearance. It is very heavy and durable. It is a popular building stone and is often found in statues.

Sedimentary rocks are characterized by a banded, layered appearance due to the different kinds of materials that were deposited, one on top of another, while the rock was forming. These rocks are built up under water by the depositing of sediments (sand, clay, mud, pebbles, or gravel). Other sedimentary rocks are made from plant and animal remains such as ferns or shells. The pressure of accumulating materials slowly forces the lower layers of sediment to cement and to harden into rock.

Many sedimentary rocks are easy to identify. Sometimes the grains of sand in sandstone are very loose and can be dislodged by rubbing two pieces of this rock together. The outside walls of public buildings often may be made of this rock. Another example of an easily identifiable rock is shale, which smells like mud when it is wet. Limestone can sometimes be identified by the plant and animal impressions (fossils) found in it.

When the physical and chemical properties of a rock have been changed by heat and pressure, it is called *metamorphic rock*. The heat may come from the friction of moving layers or from the proximity of hot magma. The pressure may result from large movements of the earth's crust that crumple and fold layers together. In this way, tiny animal skeletons and seashells were compressed at the bottom of the sea, becoming soft limestone. This sedimentary limestone was squeezed still more, and also heated by the proximity of magma. The pressure and heat melted and fused the limestone into what we call marble. The color of marble depends on the color of the sediment from which it was originally formed. Other examples of metamorphic rock are gneiss and schist. The three basic rock formations underlying Manhattan and the Bronx are Fordham gneiss, Inwood marble, and Manhattan schist, all metamorphic rocks. For a fine review of the geological structure and history of the New York City area, see *Operation New York*, available in every school.

Approaches and Concepts for the Child

Children enjoy making collections of rocks and comparing their "finds" for color, weight, shape and feel. Through this experience, the teacher guides the children to develop the skill of classification.

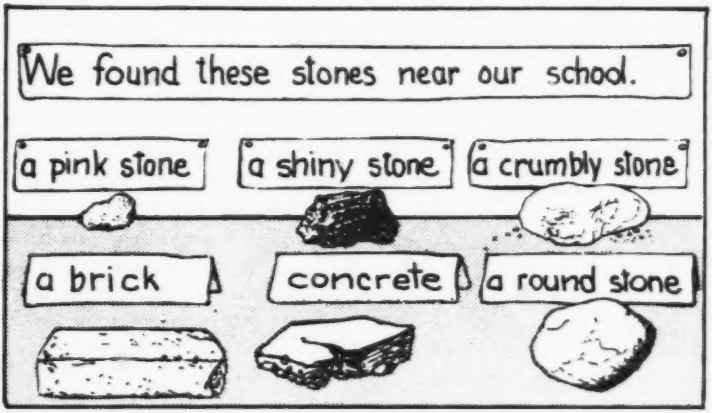
From the activities suggested, children learn the following.

There are many kinds of rocks in our neighborhood.

Rocks are different in size, color, smoothness, hardness and weight.

We can classify rocks according to these properties.

Sand is made of many tiny pieces of rock.



1. How can we make a rock collection?

Explore the neighborhood for rocks to bring to class. Undoubtedly the collection will include some man-made rock such as fragments of brick, concrete, and others. Have each child talk about his "find." Encourage the children to talk about shape, color, texture, size, and weight of the samples. Ask the children to suggest ways of organizing their collection. Some may wish to group the rocks according to size, some according to color, and some will suggest other ways.

- *There are many kinds of rocks in our neighborhood.*
- *There are many ways to make a rock collection.*
- *Rocks are different in size, shape, color, and feel.*

2. What's inside a rock?

Have children observe and discuss the outside of a piece of natural rock: its odor, texture, shininess, heaviness, color. Ask the children how they can learn what is inside a rock. Try some of the suggestions.

The children may break a rock by putting it under several layers of newspapers or in a paper or cloth bag and hitting it with a hammer. Compare the inside of the rock with the outside. Although the inside is made of the same material as the outside, it may differ somewhat in color and texture because it has been protected from external influences such as water, air, rubbing, and chemical action.

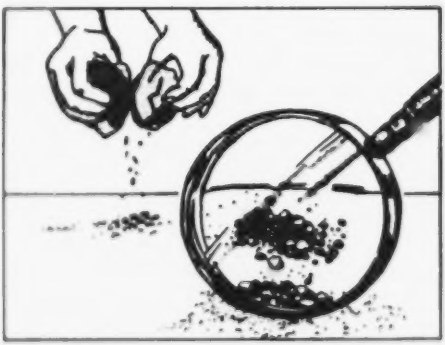
A pebble is often round or oval because it has been scoured, tumbled and smoothed for many years in a stream.

- *The inside of a rock is like the outside in many ways.*
- *The inside of a rock is different from the outside in some ways.*
- *Some rocks are harder to break than are others.*

3. What is sand made of?

Have children observe (look, feel) some sand. They will discover that there are different kinds of grains, some large, some small, some dark, and some light. Under the magnifying glass, they will find that a sand grain is "like a little rock." They may conclude that sand is made of tiny bits of rocks. These bits vary in size, shape and color.

Ask children how they might make sand. Some may suggest rubbing two rough rocks together. Compare the resulting pieces with sand particles. Some sand contains fine black particles which are iron.



Sand is made of tiny pieces of rock.

Children discover this by using a magnet to remove these particles.

- *Sand is made of many tiny pieces of rock.*
- *Sand grains come in different sizes, shapes, and colors.*
- *Sand may contain pieces of iron.*

4. How can we separate rocks from sand?

Have the children gather around a table on which there is a pile of sand and small rocks. Ask the children what they see in the pile. Discuss the shapes, colors, sizes of the fragments.

Ask the children how to separate the rocks from the sand. Allow a few children to try out their ideas. These may include picking out the rocks with their fingers, using a strainer, or using running water.

For the latter, a small amount of the sand-and-rock mixture may be placed in a basin. A stream of water is directed at the mixture, with the basin tilted. It will be seen that the small grains of sand move more readily than the heavier rock fragments, and wash over the top.

- *There are many ways to separate rock from sand.*
- *Sand may be separated from rock by straining or washing.*

5. How can we make sandpaper?

Show the children pieces of coarse and fine sandpaper. Let them investigate and guess how it was made. (Sandpaper=sand and paper.)

How can we make them stick together?

Have the children make sandpaper. Spread a mixture of mucilage and water, or glue and water on brown wrapping paper. Scatter sand lightly and evenly on the glue. (A coarse strainer will help.) Let the glue dry. Try using the sandpaper to smooth the surfaces of wooden blocks.

- *Sandpaper is made with sand, glue, and paper.*

EVALUATIVE ACTIVITIES

1. Have these lessons stimulated children to make their own rock collections?
2. Are children aware of the variety of colors in rocks and pebbles? Pebbles can be brought in by the children, compared and matched.
3. Are children looking at and using books about rocks more frequently than heretofore.
4. Can children tell us something about any of their special rocks with respect to source, color, size, shape, and hardness? (Hardness may be tested by trying to scratch the rock with the finger nail, an iron nail, a copper penny, or another rock.)
5. Can children distinguish between natural rock and man-made rock? Compare rocks from children's collection or from the science closet with such man-made rock as concrete and brick. Comparisons may be made with respect to color, sparkle, shape, and hardness.
6. Take the class on a "rock tour." See whether children have learned to distinguish the rocks in the school building as natural or man-made.
7. Do children know how sandpaper is used? What is harder, rock or wood? Rub the sandpaper on wood. What happens to the wood? What happens to the sandpaper?

D. AIR AROUND US

Background for the Teacher

We live at the bottom of an atmosphere of air which extends to a height of at least several hundred miles and exerts a pressure at the earth's surface (sea level) of approximately 15 pounds per square inch. We are not normally aware of this pressure because it pushes in on us equally from all directions and because the fluids inside our bodies push back at an equal pressure.

Air has no color, no smell and no taste. Yet air is a real substance: it takes up space and has weight. Air flows easily and is elastic. The elastic nature of air and the fact that it can be compressed or squeezed into a smaller space makes it possible for us to use it in many ways.

Air is composed of a mixture of invisible gases, the most important of which is oxygen. Nearly four-fifths of the air is nitrogen, while oxygen makes up about one-fifth. Air also contains carbon dioxide, water vapor and dust, and small amounts of helium, neon, xenon, krypton and argon.

Approaches and Concepts for the Child

Children have many experiences with air without being aware that air is a real substance. The activities suggested here help children discover for themselves some of the characteristics of air and some of the places where it can be found.

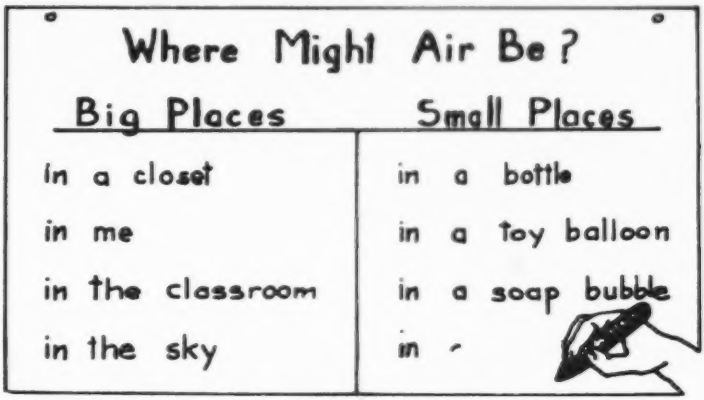
From the activities suggested, children learn the following.

Air is all around us.

Air occupies space and has weight.

Air takes the shape of its container.

Air is found in water and soil.



1. Where can we find air?

Ask children to name all the places they can think of where air might be found. They may first think of places where *they* might be breathing air such as: around us in the classroom, outside in the street, up in the sky, inside the closet, in the stairwell, in the basement.

Encourage children to name the "little places" where they think that air might be found such as: in a pocket, inside an "empty bottle," in a glass, in a soap bubble, inside a toy balloon, inside a paper or plastic bag, inside a desk drawer, inside the body, inside a box. Prepare a chart about these places.

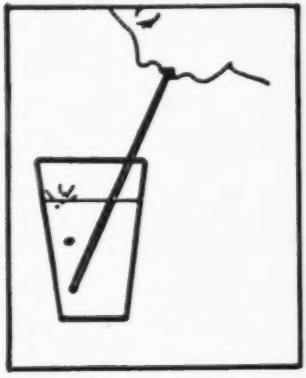
- *Air is found in many places.*

2. What happens when we blow air into water?

Ask children to suggest how they might blow air into a glassful of water. They may suggest using bubble pipes or drinking straws. (Use clean glasses, water, straws.)

Another method of bubbling air into water is to squeeze an "empty" plastic dispenser or spray bottle under water.

Have the children blow air through these devices and watch what happens, both in their own glass of water and in those of their classmates. Encourage them to experiment by blowing softly and then hard; by blowing near the surface and then deep down; by blowing a single bubble and then a stream of bubbles. Ask children to report on what they see, hear, and feel. (Air itself is invisible. We can see the space it is in.)



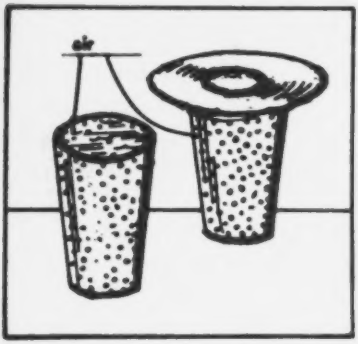
- *Air bubbles rise in the water*
- *Air bubbles break when they come to the top of the water.*
- *Air bubbles make sounds.*
- *We can feel the glass shake when we blow bubbles.*
- *We can see air if we bubble it through water.*

3. Is there air in soil?

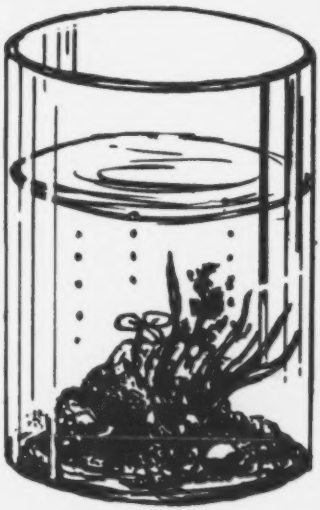
After children speculate on this problem, ask them how they might test soil to find out. Some children may suggest submerging soil in water and watching for bubbles. Obtain a lump of soil and hold it under water in a glass or jar. Watch for bubbles. What is the most likely cause of the bubbling? (Escape of air from the soil.) What needs air in soil? (Earthworms, insects, and other animals use air which is in soil.)

Add water to the dry soil in which a potted plant is growing. Listen for and observe the bubbling out of air as water soaks in. Discuss the needs of roots of plants for air. The soil in our flower pots should not be kept soaking wet because this would deprive plant roots of air.

- *There is air in soil.*
- *Many small animals can live in soil because there is air in soil.*
- *The roots of plants need air.*



There is air in drinking water.



There is air in soil.

4. Is there air in the water we drink?

Fill a glass with cold water from the tap. Let the glass stand for some time. As the water warms, the children observe tiny bubbles that form on the inside of the glass. With a pencil push some of the bubbles off the sides of the glass, and watch them rise. Children will infer that these are air bubbles. Where did the bubbles come from? Children may suggest two possibilities: They came in from the air outside the glass, or the air was in the water as it came out of the tap, but it took time for the bubbles to collect on the side of the glass.

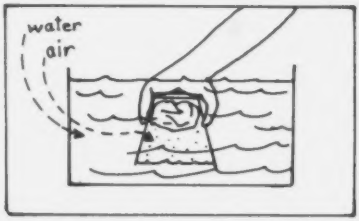
Both of these are plausible theories. How could we find out whether the air was in the water when it came out of the tap. One way is to cover a full glass of water with a saucer. At intervals compare this glass with an uncovered glass of water. Children will discover bubbles in both. (Some children may suggest a third theory: that air mixed with the water as it flowed into the glass. This is a valid hypothesis, but one that would be difficult to test at this level.)

What needs air in water? Discuss the fact that many animals and plants live in water. These forms of life need the air that is in water of ponds, streams, lakes, rivers, and oceans—and in our classroom aquarium.

- *There is air in the water we drink.*
- *There is air in the water of ponds, lakes, and oceans.*
- *Plants and animals that live in water need air.*

EVALUATIVE ACTIVITIES

1. Is there air in the cracks of rocks? How can we find out? (Gently lower a rock into water in a glass jar. Note whether air bubbles come from the rock.)



2. Put a handkerchief in a glass and place the glass (inverted) into a tank of water. Ask the children to tell what they think is happening to the handkerchief. Remove the glass, and allow children to inspect the handkerchief. Why is it dry? (The air keeps the water out and allows the handkerchief to stay dry.) What does this show about air? (Air keeps water out; air fills the glass; air is real.)

3. Do you find that children are using expressions and concepts they did not have previously? For example, do they say "an empty bag" or "a bag filled with air"? Are they asking questions about air and are they looking at books which illustrate simple experiments with air?

BASIC SUPPLY LIST
FOR *WATER, SOIL, ROCKS, AND AIR*

* indicates quantity for entire class; other quantities specified are for each group of 4 children

A. Water

E-1: Science Supply List

1 cup of Sand	*2 lengths of Rubber Tubing	*2 lengths of Plastic Tubing
*4 Magnifying Glasses		

G-1: General Supply List

*2 Basins	*1 Pitcher	*1 ball of String (warp, thread. white)
*1 pkg. Blotters	*Funnels of assorted sizes	
2 sheets Construction Paper	*Assorted Show Card Colors	*2 Trays
Small Wooden Blocks		*1 bottle of Ink

Miscellaneous

*Assorted Jars
2 Plastic Bags
*1 Clothes Sprinkler
2 Coffee Cans
1 shallow plastic Dish
2 iron Clothes Hangers
*1 cup Flour
*1 Watering Can with large round nozzle
*1 Rubber Bulb with perforated nozzle
2 Cups
*Assorted Cans
*1 Sieve
Squares of nylon, rayon, cotton, plastic, rubber, water-proofed materials
*1 pkg. of Marbles
*1 cup of Salt
Wooden Beads
*1 Clothes Sprinkler
*Assorted Glass Tumblers
Waxed Paper
*1 Colander
2 sheets Aluminum Foil
2 Plastic Sheets
*1 cup of Sugar
*2 pkgs. Vegetable Dye
*1 Watering Can with long spout
*1 Atomizer

B. Soil

E-1: Science Supply List

*8 Flower Pots
*4 Magnifying Glasses
1 cup of dry Soil

G-1: General Supply List

1 Dixie-mesh square
2 sheets of Paper
2 large sheets of Cardboard

Miscellaneous

Garden Soil
*1 Coarse Strainer
*1 Watering Can

C. Rocks

E-1: Science Supply List

1 cup of Sand

G-1: General Supply List

*2 Hammers
*2 Basins
*1 jar Mucilage or Glue
2 sheets of brown Wrapping Paper

Miscellaneous

*Samples of Rocks in the locality
2 pieces coarse Sandpaper
Several layers of Newspaper

D. Air

E-1: Science Supply List

*2 cups of Soil

G-1: General Supply List

8 Drinking Straws

Miscellaneous

*4 Glass or Plastic Tumblers
*2 Plastic Squeeze Bottles
2 Saucers
*4 Bubble Pipes

Moving in the Air

A. FLYING ALONG

Background for the Teacher

Air is a real substance, as real as water (a liquid) or as rock (a solid.) It offers resistance to any object moving through it in any direction. A sheet of paper falling horizontally through the air pushes against the air in its way. The air, being real, pushes back, and slows the fall of the paper. On the other hand, a tiny crumpled piece of paper does not have as large a surface to push against the air. It will, therefore, make a relatively fast descent when dropped from a given height.

Parachutes, with their great surface pushing against the air, are used by flyers or parachutists returning to earth, for slowing down space capsules, and for supplying disaster areas with food and clothing.

Approaches and Concepts for the Child

Children observe paper, leaves, seeds, and dust move on a windy day. Overhead they see airplanes, helicopters, birds, and clouds. They try

to guess the relative height of each object and comment on the direction and speed of its motion. Many first-hand experiences will help children see more clearly the role of the air in which these objects move.

Children enjoy making and launching paper gliders and comparing the performance of different models. They also release blown-up balloons and compare the flights with those of jets and rockets.

From the activities suggested, children learn the following.

Wind is moving air.

Wind carries many things.

Some things fly high; some things fly low.

A parachute slows the fall of an object that hangs from it.

Engines can move something through the air.

Rockets and jets move in the opposite direction from that of the escaping gases.

1. What moves through the air?

Have the children look out the window and list the things they see moving in the air. They may also recall items they saw in the air on windy days, on rainy days, and on calm days. Children tell about falling leaves, paper, seeds, dust, drops of water, snow, and ice.

In each case discuss how these objects came to move through the air. Were they released from a height such as an upper story window? Did the wind pick up the objects and blow them upwards? Do these things

come from far away? In what direction is the object moving: up, down, across, or in some other way? How fast is it moving?

Some objects, such as airplanes, have engines which make them go up and stay up for a long time.

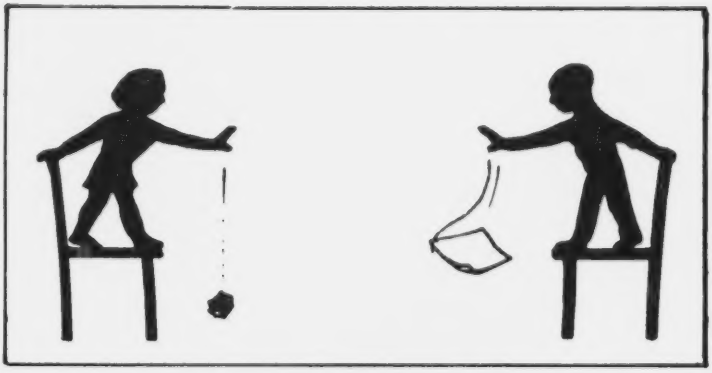
- *We see many things moving in the air.*
- *Some things are moved by the air itself.*
- *Some things are made to move by engines.*
- *Some things are pulled to the ground by the earth's gravity.*

2. How fast does a piece of paper fall through the air?

Ask the children to recall seeing slowly falling objects such as leaves, pages of a newspaper, snowflakes, gliding birds with outstretched wings, gliders, and parachutes.

Ask the children to describe how a flat piece of paper falls through the air. Give each child an 8½ x 11 inch sheet of paper with which to experiment and compare with their recollections. Ask them to drop the paper to the floor in as many different ways as they can. Include dropping it, edge down. They also release a paper held horizontally.

How long does it take for the paper to reach the ground? Several children may conduct a test of the "falling time" by standing on chairs and releasing the sheets from the same height at the same time. If a watch or clock with a second hand is available the exact time may be noted. Inevitably a "falling-time race" will develop out of this activity.

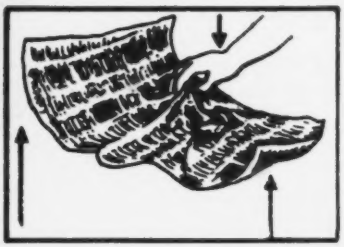


The crumpled paper falls faster.

Children will launch the paper in different positions. Some child will think of crumpling the paper up into a small ball before dropping it.

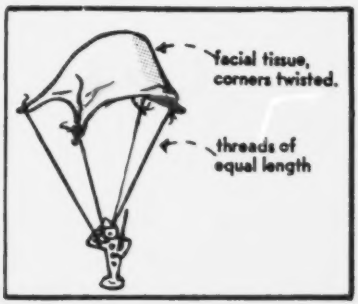
Discuss the reason for the difference in falling rates between the crumpled and the flat sheet of paper. The children will infer that the flat sheet of paper is slowed in its fall because it is pushed back by more air. The crumpled paper, because of its size, hits less air. No doubt the children will find their own ways of saying this, and should be encouraged to do so.

To see and feel this difference, allow children to try pushing two sheets of newspaper down: a flat sheet held by a pinch in the center with one hand, and a crumpled sheet in the other hand. They will note that the "wings" of the open sheet are pushed up as the paper moves down.



Air pushes up as the paper is pushed down.

- *A piece of paper falls more slowly when it is flat than when it is crumpled.*
- *Air slows falling things.*



3. Why is a parachute used?

Ask the children how a pilot can jump from a flying airplane and land safely on earth. The children have seen parachutes in books, moving pictures, on television, or in toy shops. Have them discuss what they know about them. Ask for ideas for making parachutes in class. A simple parachute can be made by (or for) each child as follows. Twist the 4 corners of a square of facial tissue. Tie, staple, paste, or tape to the corners four equally long pieces of thread. Tie the loose ends of the threads together around a piece of chalk, a crumpled ball of paper, a spool or a toy figure. This weight should be tied so that it hangs below the *center* of the opened parachute.

Fold the parachute and test it by throwing it into the air and letting it drop. Observe how the air fills the parachute. Notice how slowly it

floats to the ground. To drop the parachute from a greater height, hang it from the top of a window pole and shake it loose near the ceiling.

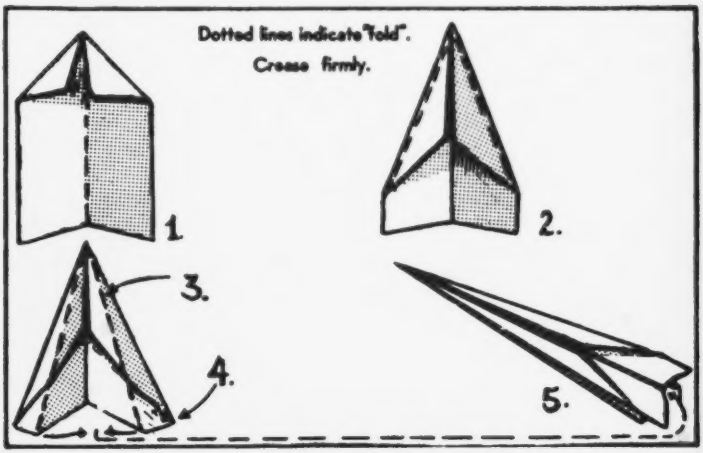
Compare the fall of the object which is attached to the parachute with the fall of a similar object dropped in the same way, at the same time, and from the same height without a parachute.

Encourage the children to experiment by making their parachutes of different materials, by varying the length of the strings, by varying the weight supported by the parachute.

- *A parachute fills with air when it falls.*
- *An open parachute slows the fall of an object.*

4. What helps paper gliders fly?

Children construct gliders of paper as shown in the illustration. They fly them in the schoolyard or basement to observe how they move through the air. They measure and compare the distances and durations of the various glider flights.



To make a glider, using 8½" x 11" paper:

1. **Fold lengthwise; then fold parallel to center fold.**
2. **Fold again, parallel to center fold.**
3. **Fold BACK, parallel to center fold.**
4. **Pinch together to form glider.**

Compare the glider flights with that of a similar-sized sheet of paper which is crumpled into a ball and thrown. Why does the glider stay up longer? The children may infer, from their previous experiments with falling paper, that the air helps slow its fall. The arrow or V-shape helps the glider move easily in its forward path through the air.

- *The air under a glider help slow its fall.*
- *The shape of a glider helps it fly through the air.*

5. How can we make a rocket blast off?

Discuss how a rocket launches a spaceship. The children know about the countdown and the blast-off at zero. Call attention to the fact that the blasting flames and gases shoot *down*, and the rocket begins to move *up*. The children should also be aware that even during level flight, the rocket is moving in the direction opposite to the direction of the gases leaving the rocket.

Using a picture, a simple diagram, or a toy model, ask all the children to point in the direction toward which the gases are going. Then ask them all to point in the direction the rocket is moving. In each case emphasize that the direction of flight is *opposite* to the direction of the escaping gases.

Since we cannot use a real rocket in class, what can we use instead to show a kind of "blast-off"? Blow up a balloon and hold it with the opening down before releasing it. Ask the children to watch what happens the moment you let go.

It is sometimes possible to eliminate the wild gyrations of an inflated and then released balloon by weighting it as follows: Cut a 2" x 2" square of oaktag. Pierce the center with a pair of scissors or a sharp pencil and insert the neck of the balloon through the hole. Experiment with the size of the square and the size of the hole until the best results are obtained.

- *Hot gases shoot out from the bottom of a rocket as it moves up.*
- *A rocket moves in a direction opposite to its blast.*

6. What do we need for an airplane and spaceship show?

Ask children to display and demonstrate any of their homemade or purchased toy airplanes or spaceships. They may also bring pictures or books describing aircraft and spacecraft. In these demonstrations and discussions the children may identify simple parts of an airplane such

as the tail, wings, propeller, body, rudder, wheels, landing gear, engines, and cockpit. Simple pictures may be made to help in the identification.

The children observe that model airplanes and spaceships are made of many different materials, yet all contain similar parts. Lightweight materials such a balsa wood or paper are used for models which can fly. They learn that propellers on some models are turned by rubber bands. Some models have controls which may be preset. Allow the children to ask each other questions about their toys.

- *Propellers on toy or model planes may be turned by rubber bands, springs, small electric motors, or tiny gasoline engines.*
- *Airplane models that fly are made of lightweight materials.*

EVALUATIVE ACTIVITIES

1. Which will fall more slowly? Can the children express themselves by using words and concepts learned in class? For each pair of items ask the children to select the one which will fall more slowly, and to tell why. Show pictures or real samples of the following.
   a. Flat sheet of paper and crumpled sheet of paper. (Flat sheet of paper: it hits more air and is slowed more by the air.)
   b. Weight (ball or clay) and same weight attached to a parachute. (Weight attached to parachute: parachute is slowed more by air.)
   c. Dandelion seed attached to its silk ("parachute") and dandelion seed separated from its silk. (Seed attached to silk: air slows it more.)
   d. Small parachute with weight and large parachute with same weight. (Usually, the larger parachute will fall more slowly because it hits more air which pushes back. Possible exception may occur if parachute is very large in relation to attached weight and consequently is not pulled into an open upright position.)
2. Hold one edge of a sheet of paper and pull it through the air. Why does the free end of the paper rise? (Because it hits the air and the air pushes it up.)
3. Show picture of sailboat with sails full. What is moving the ship?(Moving air, or wind.)
4. Why do some large outdoor signs and awnings have large holes cut in them? (So that strong wind can slip through the holes and not blow too hard on the objects. Then the wind will not break or tear them.)
5. Why do some spaceships use parachutes before landing in the ocean or

on land? (To slow them for a safe landing.) Why *don't* spaceships landing on the moon need parachutes? (There is no air there to slow them.)

6. How would you find out which of the following parachute materials slows the fall the most: silk, cotton, nylon, rayon, wool? (Use pieces of equal size and shape. Form into parachutes. Attach equal weights. Drop from the same height. See which hits the floor last.)

BASIC SUPPLY LIST
FOR *MOVING IN THE AIR*

* indicates quantity for entire class; other quantities specified are for each group of 4 children

E-1: Science Supply List

4 Balloons

G-1: General Supply List

12 sheets of Paper (8½ x 11)
*1 roll Cellophane Tape
2 pieces Chalk
1 pair Scissors
2 sheets Oaktag (2" x 2")

Miscellaneous

4 sheets Newspaper
4 sheets Facial Tissue
2 empty Spools
2 Toy Figures
*Model Rocketships
*Model Airplanes
*Model Spaceships
1 spool of Thread

A "Green Thumb" in the Classroom

The classroom is home for about one half of the waking hours of teachers and students alike. It becomes more cheery and colorful with the addition of plants which can be cared for by the children. Teachers and children can acquire "green thumbs" by putting them in soil. If there are different kinds of plants in a room there will be opportunities to meet the problems presented by each. Children should be encouraged to observe the plants, report on their growth and try to find the best ways of caring for each kind.

The hardy plants used most often in the classroom are: geranium, everblooming begonia, coleus, tradescantia, philodendron, pothos, English ivy, grape ivy, crassula, ferns, cactus, snake plant, nephthytis, Chinese evergreen, dracaena, pick-a-back, peperomia.

Children can also grow sweet potatoes, beet and carrot tops, seeds of avocados, squash, watermelons, pumpkins, grapefruit, lemons, oranges, apples, peaches, cherries, lima beans, and sunflowers. See illustration on page 183.

Bulb growing, of course, is a well-established custom in schools. See illustration on page 184.

In the spring, marigold, nasturtium, or petunia seeds will produce attractive and hardy plants which can be grown in school.

Covered terraria can be made with gravel and soil in a fish tank or bowl or a large mustard jar obtained from the neighborhood delicatessen. See illustration on page 184.

Plants will grow successfully if the following are provided:

Sufficient water. Plants should be watered only when the soil feels dry, However, when adding water give the soil a through soaking, not just a sprinkling.

Good drainage. The pot or box should have holes in the bottom to allow excess water to escape. (The roots of a plant require air. Water which remains may prevent air from entering the soil.) Saucers or aluminum pie plates under flower pots will protect the woodwork and catch drained water. One can water plants by adding water to the saucer until the top of the soil is moist. (Empty the saucer of any water which remains after the soil is moist.)

Suitable temperature. Plants should not be placed on hot radiators or in hot or cold drafts. Protect plants over cold weekends.

Proper light conditions. Experience is the best teacher here. A geranium, for example, needs a good deal of sunlight. Cactus also thrives in sun-

light. Begonias and some ferns, on the other hand, should not be kept in direct sunlight for many hours at a time. Most plants will grow well with only a few hours of sunlight. Many will need only the light from the sky. No green plant, however, will do well in a dark area.

Good Soil. While each plant has its own soil requirements, any good garden or potting soil will usually be satisfactory. The addition of sand will make the soil more porous. If the soil dries too quickly peat moss or humus can be added. Commercial fertilizer may be used, but only according to the directions on the package. *Note:* When transplanting, take care to avoid injuring the roots.

Other care. Leaves should be showered or washed with a sponge from time to time. Insect pests can be removed by washing or by using specific insecticides.

Children may interview someone in the school or neighborhood who has had notable success in growing plants and report to the class on the advice obtained. There are also good books on household plants in any library.

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Films and Filmstrips

This list of sound film and filmstrip resources has been prepared to implement the teaching of *Science: K-2*.

All listed films and filmstrips have been approved by the Board of Education. Annotations are based on evaluations by committees which have carefully screened the films and filmstrips for city-wide use. Grade placement and utilization in individual schools should be based on local previewing and adaptation to specific needs. Recommended filmstrips must be purchased by individual schools since they are not available on loan. Board of Education order numbers follow some annotations.

All films are sound motion pictures, 16 mm. width, and may be available on loan from the *Central Loan Collection* of the Bureau of Audio-Visual Instruction. Consult the Bureau's listings in *Instructional Films and Tapes* for borrowing procedures. Many of the films listed are also available at the local film centers. Schools should consult film center lists and direct their requests to these centers before requesting service from the *Central Loan Collection*.

For approaches to the use of films and filmstrips, see *Audio-Visual Materials In The Science Program*, on pages 14-15.

Magnetism and Electricity

FILMS

MAGNETS — 14 min. — McGraw-Hill

Children's magic show is vehicle for father's demonstration of magnetism. Lodestone; making a magnet, magnet as compass; repulsion of like poles; attraction of opposite poles; characteristics of magnetism.

MICHAEL DISCOVERS THE MAGNET — 10 min. — E.B.F.

A boy becomes interested in magnets from a new magnetic bulletin board in the kitchen. He experiments with magnets and learns their properties.

MAGNETS AND THEIR USES — 10 min. — Film Associates of California

This film is designed to help students learn what magnets are, what they do, and how they are used. Demonstrations illustrate that a magnet has two poles, each different from the other. We learn of the characteristics and properties of magnets.

FILMSTRIPS

DIFFERENT KINDS OF MAGNETS — Jam Handy

Magnets of many shapes and sizes attracting things made of iron or steel. Explains "poles" in magnets and where the strength of a magnet is greatest.

DISCOVERING MAGNETS — Jam Handy

An introduction to the study of magnets for young children. Magnets attract objects containing iron.

MAGNETS (ELEMENTARY SCIENCE SERIES) — McGraw-Hill

Demonstrates the nature and behavior of magnets. Based on the activities of two children who learn what a bar magnet is, and some things it can do.

MAGNETS CAN ATTRACT THROUGH OBJECTS — Jam Handy

Magnets attract through cloth, plastic, rubber, and water. Many experiences for children to try in the classroom.

WORKING WITH MAGNETS — Eye-Gate

Magnetic qualities of iron and steel are shown. Types and shapes of magnets. The construction of the compass is illustrated. Attraction and repulsion of poles is treated.

Earth in Space

FILMS

SEASONS OF THE YEAR — 10 min. — Coronet Instructional Films

The four seasons are investigated, with attention given to plant life, the changing weather, and the change in the length of shadows of children. Simple, clear and related to everyday changes.

Living Things

FILMS

ADVENTURES OF A CHIPMUNK FAMILY — E.B.F.

Story of a chipmunk family from early spring to winter. Includes summer training. Shows digging of burrow, food gathering.

ADVENTURE WITH ANDY — McGraw-Hill

Andy is a baby orangutan (app. 2 years old) who lives in the Bronx Zoo. This is a story of a day in his life, a day that begins with mishaps.

ANIMALS AND THEIR HOMES — 11 min. — Coronet

Presents animals building homes in water, on the ground, in trees and underground. The functions of homes and how they are built.

ANIMAL FRIENDS — Film Associates of California

Story of Kitten and Shep playing, eating, and resting.

ANIMAL HOMES — 11 min. — E.B.F.

A wide variety of animals and their homes are shown.

ANIMALS IN AUTUMN — E.B.F.

Changes in autumn: storing food, changing color, and migrating.

ANIMALS IN CLOSEUP — 8 min. — Pathe News, Inc.

Guessing game at Bronx Zoo wherein viewer tries to identify the animal after seeing a picture of only part of the animal.

ANIMALS IN SPRING E.B.F.

Many small animals in their natural environs during early spring. Birds, peepers, turtles, tadpoles, robins and bluebirds.

ANIMALS IN SUMMER 11 min. E.B.F.

Some common woodland animals in summer, seeking food and sheltering their young.

ANIMALS PROTECT THEMSELVES 11 min. Coronet

Billy, his father, and their dog take a walk through the woods and discover ways animals have of protecting themselves from enemies.

ANIMALS—WAYS THEY EAT 11 min. E.B.F.

Different ways in which different animals obtain their food and eat it. The adaptations shown are feet, claws, wings, legs, bills.

ANIMALS—WAYS THEY MOVE 11 min. E.B.F.

A variety of animals and how they move.

BILLY AND NANNY (GOAT TWINS) 11 min. E.B.F.

Illustrates the traits and habits of domesticated goats on a farm. Describes their feeding, milking, and care.

BIRDS OF THE COUNTRYSIDE 11 min. Coronet

Describes six birds: indigo bunting, meadowlark, nighthawk, red-tailed hawk, kingbird, and killdeer.

CARE OF PETS 11 min. E.B.F.

How household pets are cared for by children. Includes canary, goldfish, cat, and dog.

CAT FAMILY 11 min. Int'l. Film Bureau

Shows animals that differ greatly in size, color and habitat, yet possess common characteristics which makes them akin.

CHILDREN IN AUTUMN E.B.F.

Children observe autumn changes: color, weather.

CHILDREN IN SPRING E.B.F.

Signs of spring are observed in plants and animals. A garden is planted.

CHILDREN IN SUMMER E.B.F.

Children observe colts, goats, and sheep. They fish and pick berries. Insects, animals, flowers in a garden, dusk and a rainstorm are observed.

CHILDREN IN WINTER E.B.F.

The characteristics of winter and children's outdoor activities as affected by them.

CHIPMUNK AND HIS BIRD FRIENDS Bailey Films

A true story of the adventures of a chipmunk and his bird friends.

CITY PETS, FUN AND RESPONSIBILITY 11 min. Coronet

Some of the pets commonly found in a city—dogs, cats, hamsters, white mice, parakeets, canaries, and goldfish—and the ways in which their owners care for them. Stresses that domesticated animals need special care and helps children realize their responsibility toward their pets.

ELEPHANTS 11 min. E.B.F.

Setting: a farm in which elephants are trained for circus performance. Physical features, food, methods of eating, drinking, and cleansing themselves.

FARM ANIMALS 11 min. E.B.F.

The animals on the farm, their care, young, and use to man.

FOREST BABIES 11½ min. Grover-Jennings

Animals in the forest in late spring; shows how the young grow and learn to take care of themselves by summer's end.

FRISKY THE CALF 10 min. Coronet

Children are taken into a barnyard where they see how a calf is handled.

FUN AT THE ZOO 12 min. United World

Trained lions, tigers, elephants, and chimpanzees of the St. Louis Zoo demonstrate a wide variety of skills.

GRAY SQUIRREL 11 min. E.B.F.

Story of three young squirrels and their mother. Follows the growth and daily activities of the young squirrels from spring to midwinter. We see the mother squirrel feeding and caring for her young and the young squirrels as they learn to climb and hunt for food.

GROWTH OF FLOWERS 11 min. Coronet

Miracle of growth revealed through time-lapse photography. Some flowers seen: zinnia, gladiola, water lily, rose, Jack-in-the-pulpit.

HAPPY LITTLE HAMSTERS McGraw-Hill

Story of a hamster courtship, motherhood and 8 children.

HOW ANIMALS HELP US Coronet

Shows farm animals and their importance to man.

HOW ANIMALS LIVE IN WINTER 11 min. Coronet

How the common animals of the woods get their food in winter; how they live and protect themselves.

HOW BIRDS HELP US Coronet

How birds provide us with food, destroy harmful insects and rodents, and eat weed seeds.

HOW DOES A GARDEN GROW? 11 min. Film Associates of California

Cycle of growth from seed to flower shown by boy as he tends a garden.

HOW INSECTS HELP US Coronet

Shows how insects help man.

KANGAROOS 11 min. E.B.F.

Shows kangaroos from the time they are born, what they eat, how they behave in their natural environment in Australia, who their enemies are, and how they defend themselves.

KITTENS, BIRTH AND GROWTH Bailey

Four kittens from birth until the time when they can get solid food.

LEARNING ABOUT BEARS 11 min. E.B.F.

Shows habits of black bear. The training of its cubs.

LITTLE ANIMALS 11 min. Dowling

Deals with idea that there are many kinds of insects and that they are animals.

MR. AND MRS. ROBIN'S FAMILY Coronet

Life cycle of robin.

MOTHER DEER AND HER TWINS 11 min. E.B.F.

Story of twin fawns and how they are cared for by the mother deer.

OUR ANIMAL NEIGHBORS 11 min. Coronet

Appearance and habits of the rabbit, gray squirrel, fox squirrel, chipmunk, gopher, deer mouse, meadow mouse, shrew, mole, and bat.

ROBIN REDBREAST E.B.F.

Life story of the robin.

SHEP, THE FARM DOG 11 min. E.B.F.

Activities of a collie farm dog. We see him taking cows to pasture, routing chickens from the garden, eating, and burying a bone.

SPOTTY: STORY OF A FAWN 10 min. Coronet

Adventures of a wild fawn filmed against the background of the north woods.

SPRING IS AN ADVENTURE 11 min. Coronet

A child notices the evidences of spring: bees, crocuses, a baby robin, a groundhog, tadpoles and seeds.

SPRING ON THE FARM 11 min. E.B.F.

Shows the adaptation of plants and animals to the changing seasons. Two children see buds swelling, birds returning, grass becoming green, fruit trees blooming, the planting of gardens, moths coming out of their cocoons, the young rabbits coming out of their nests.

SUMMER IS AN ADVENTURE Coronet

Two children visit the country and learn about summer and how it affects living things.

SUMMER ON THE FARM 11 min. E.B.F.

Two children observe the growth of plants and animals during the summer.

TEETH ARE TO KEEP 11 min. E.B.F.

Animated cartoon on the care of the teeth. Centers around a picnic.

THE TREE 10 min. Dimension Films

Beauty and importance of trees is stressed. Also deals with the concept that living things depend on each other.

WATER PETS 5 min. Pathe News Inc.

Deals with whales and porpoises.

WE EXPLORE THE BEACH 11 min. Coronet

Birds, ship buoy, lighthouse, effects of the tide, sea shells, starfish, clam, horseshoe crab, fishing boat, wind blowing sand and water.

WINTER ON THE FARM 11 min. E.B.F.

Adaptation of plants and animals to winter. Two children observe animals making tracks in the snow, birds at a feeding station, farm animals in a barn.

ZOO ANIMALS OF OUR STORYBOOKS 10 min. Coronet

Shows zoo animals in action, at close and long range: bears, elephants, foxes, lions, zebras, and giraffes.

ZOO BABIES Coronet

Children observe the behavior of hamsters and zoo babies.

ZOO FAMILIES Film Assoc. of California

Adults and babies of zoo animals such as monkeys and kangaroos.

FILMSTRIPS

ANIMAL BABIES Children's Press

How animal babies are cared for. Includes bat, lion, opossum, skunk, rabbit, and bear.

BIRDS OF THE CITY Bowmar

Neighborhood birds: physical characteristics and habits. Includes pigeons, sparrows, bluejays, grackles, starlings, gulls.

FAMILIAR ANIMALS AND THEIR FAMILIES S.V.E.

MR. AND MRS. MALLARD AND THEIR FAMILY

Shows habits of mallards throughout the year; includes migration.

MR. AND MRS. ROBIN AND THEIR SPRINGTIME FAMILY

Shows life of the robin. Includes migration, nesting, and growth of the young.

MRS. SQUIRREL AND HER FAMILY.

Story of the squirrel during one year.

FINDING OUT HOW ANIMAL BABIES GROW S.V.E.

Shows growth of animals. Some animals do not change much (cat, turtle) and some, like the frog, change a good deal.

FINDING OUT HOW ANIMALS LIVE S.V.E.

Where animals live, what they eat, how they protect themselves.

HOW DO PLANTS GET WHERE THEY GROW? Filmstrip House

Explains how seeds are dispersed.

LARGE ZOO ANIMALS E.B.F.

Animals included are the seal, porpoise, wild sheep, deer, reindeer, rhinoceros, elephant, tiger, lion, camel, bear, and antelope.

LIVING THINGS—ANIMALS Visual Education Consultants

Photos of common animals: cat: elephant, chicken, cow; the foods they require for growth; the ways they help us; how we help them.

MR. AND MRS. BEAVER AND THEIR FAMILY S.V.E.

The family life of the beaver from spring through winter season. Includes descriptions of their island home, construction of a beaver lodge, and instruction of the young in survival techniques.

MRS. BEAR AND HER FAMILY S.V.E.

Begins with bears in their winter den. Shows family of bears' eating habits, method of communication and protective adaptations. Describes preparations for hibernation and training of cubs toward independence.

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MRS. COTTONTAIL AND HER SPRINGTIME FAMILY S.V.E.

The life and habits of cottontail rabbits in their natural habitat. The upbringing of the family and how the young adapt to their environment.

MONKEYS AND OTHER ZOO ANIMALS E.B.F.

Small zoo animals included are: apes, gibbons, marmosets, wolves, foxes, wild dogs, jungle cats, lynx, mice, rats, and guinea pigs.

OWLS Bowmar

Different types of owls. The eating habits, survival of owl chicks.

PETS Ives

Describes pets and how to care for them. Includes goldfish, rabbits, hamsters, cats and dogs. (True Book Filmstrips of Biological Science).

POLAR BEAR Bowmar

Shows the life of the polar bear.

Sound and Light in Communication

FILMS

LEARNING ABOUT SOUND 9 min. E.B.F.

Simple explanation of the topic of sound; how it may be produced; how sounds are made louder and softer; how sound is carried. 345.32.

SOUNDS ALL ABOUT US 11 min. Coronet

A child becomes interested in sound via the television set. Pitch, loudness, quality are developed by means of simple experiments using musical instruments. 557.3.

SOUNDS AROUND US 27 min. WNYE Kine

How sounds tell us what is happening; how some sounds are made. Simple sound makers we can all use.

FILMSTRIPS

SCIENCE IN EVERYDAY LIFE
SOUNDS AROUND US Eye-Gate

Many meaningful sounds in the child's environment are discussed. 37360.16.

SOUNDS WE HEAR Ives

Vibrations cause sounds. There are many different kinds of sounds; some are pleasant and some noisy. Animals make a variety of sounds. Simple experiments are suggested for demonstrating vibrations as the case of sound.

Weather

FILMS

BLOW, WIND, BLOW 11 min. Coronet

Story of the wind both as a help and as a destructive force.

CHILDREN IN AUTUMN 11 min. **E.B.F.**

Signs of autumn: changes in plants, animals and the farmers' seasonal activities.

CHILDREN IN SPRING 10 min. **E.B.F.**

Seasonal activities in relation to spring are shown. Signs of spring are observed: swelling buds, flowers on trees, tadpoles, and the appearance of birds, rabbits, skunks. A garden is started by planting seeds and seedlings.

CHILDREN IN SUMMER 11 min. **E.B.F.**

Children observe colts, goats, and sheep. They go fishing and pick berries in gardens. Many insects, animals, flowers and fruits, a summer storm, and the setting sun are observed.

CHILDREN IN WINTER 11 min. **E.B.F.**

A review of the characteristics of winter, and how children's outdoor activities are affected by this season.

HOW WEATHER HELPS US 11 min. Coronet

Hot weather is good for play, growing plants; rain helps crops; snow keeps ground from freezing.

SNOWFLAKES Moody Inst.

Depicts the use of snow for recreation, as a source of water, etc.

SPRING BRINGS CHANGES 11 min. Churchill-Wexler

Depicts the gradual change from winter to spring—plants, animals, and changes of clothing for two children.

SPRING ON THE FARM 11 min. **E.B.F.**

Shows the adaptation of plants and animals to the changing seasons. Two children see buds swelling, birds returning, grass becoming green, fruit trees blooming, the planting of gardens, moths coming out of their cocoons, and young rabbits coming out of their nests.

SUMMER ON THE FARM 11 min. **E.B.F.**

Two children observe the growth of plants and animals during the summer.

WHAT THE FROST DOES 10 min. Coronet

A boy finds a pumpkin in his father's field, and eagerly watches for frost time to pick it. Signs of seasonal changes are depicted.

WHATEVER THE WEATHER 10 min. Educational Horizons

Weather facts are explained in this introduction to wind, rain, snow, and sun.

WINTER ON THE FARM 11 min. **E.B.F.**

Adaptation of plants and animals to winter. Two children observe animals making tracks in the snow, birds at a feeding station, farm animals in a barn.

FILMSTRIPS

AUTUMN IS HERE Jam Handy

PEOPLE GET READY FOR WINTER

Weather in autumn gets colder, children have to wear coats, the thermometer shows a shorter red line, it becomes windy, shadows become long and leaves change color.

CLOTHES AND THE SEASONS — Curr. Mat. Corp.

How to dress properly for the seasons. 36685.

FUNDAMENTALS OF SCIENCE — Eye-Gate House

AIR, WIND AND WEATHER

Develops the theme that children, animals and plants need air; that air is used in many ways; that air is related to wind and weather. 37360.1.

AUTUMN AND WINTER

The characteristics of autumn and winter are shown. Plants, harvests, clothing, fun with ice and snow are illustrated.

LEARNING ABOUT THE SEASONS — Society for Visual Education

A WALK IN THE RAIN

A small boy and girl have simple experiences in the rain while wearing rain gear. 37910.1.

GOING ON A PICNIC

Young boy and girl go on a picnic with their parents in the summertime. They learn about flowers, trees, streams and mountains. 37910.11

GETTING READY FOR WINTER

Children observe how plants and animals adapt to cold weather. 37910.13

WHEN AUTUMN COMES

A small boy and his sister learn how people, plants and animals change in autumn. 37910.14

SEASONS AND WEATHER — McGraw-Hill

A FOGGY AND WINDY DAY

Shows that wind can do work—e.g., move sailboats, scatter seeds, and that it can also do damage. Shows weather vane as a direction indicator. Discusses fog and the problems created by fog. 39300.12

A HOT DAY

Shows some experiences of a hot summer day. The children discover that some materials warm more readily than others; one reason it is warmer in the summer is because the sun is in the sky a longer time; sweating helps us to keep cool. 39300.13

A RAINY DAY

Shows the effects of rain; how people protect themselves from rain; how clothing dries by evaporation in the sun; how water evaporates into the air. 39300.14

A SNOWY DAY

Explains why winters are cold and we have snow; how animals protect themselves against the cold; how children play in the snow, how snow melts as spring approaches.

WEATHER CHANGES — Eye-Gate House

The many kinds of weather children experience such as sun, cold, wind, rain, snow; foggy, frosty, cloudy and clear days. How we adjust to various weather conditions. Kinds and uses of various thermometers are illustrated. 37365.15

Motion and Force in Transportation

FILMS

MACHINES THAT MOVE EARTH — Film Associates of California

The work of great machines which move earth; power crane, power shovel, bull dozer, dump truck.

INTRODUCING AIR — Bailey Films

Simple science lesson told in story form relates to air as a real substance which takes up space and moves things.

FILMSTRIPS

AIR HELPS THINGS MOVE IN WATER 37250.12 — Jam Handy

FUNDAMENTALS OF SCIENCE — Eye-Gate House

OFF WE GO

Walking, beasts of burden, rafts, boats, carts, chariots, wagons, and automobiles. Development of transportation in this country: the covered wagon, stagecoach, pony express, steamboat, locomotive, automobiles, planes, helicopters, and rockets.

ROLLING ALONG

The use of wheels is shown by comparison with round and disc shapes, and then by portraying a variety of machines using wheels, including automobile, bus, truck, wagon, baby carriage, and scooter. 37360.15

RAMPS — Jam Handy

Children in school using a slanted board to lift a heavy box from floor to table, a truck using a ramp for unloading boxes; other uses of ramps are shown. 39440.53

Earth and its Resources

FILMS

YOUR FRIEND THE SOIL 11 min. — E.B.F.

Through the aid of animation, this film shows how good soil helps supply our basic food needs. It briefly demonstrates the bad effects of erosion on our food supply.

INTRODUCING AIR — Bailey

A simple science lesson told in story form. It tells how a father, taking his children on a sailboat ride, explains that while we cannot see air, it is very real, it takes up space, it touches everything around us, and it makes us feel warm or cold.

FILMSTRIPS

A WALK IN THE RAIN 37910.1 — Society for Visual Education

A boy and girl have simple experiences with the rain while wearing rain gear.

AIR IS EVERYWHERE 37360.1 Eye-Gate

Uses simple experiments to show that air is everywhere, e.g., catching air in plastic bag; bubbles of air collecting in water.

AIR, WIND AND WEATHER 37360.1 Eye-Gate

Develops the theme that children, animals and plants need air; that air is used in many ways; that air is related to the wind and the weather.

BASIC PRIMARY SCIENCE: GROUP III S.V.E.

FINDING OUT HOW THINGS CHANGE

The effect of heat and cold on water; which things can be changed by air or water; what changes living things make. 36483.36

CONSERVATION FOR BEGINNERS Bowmar

A PICNIC FOR DICK AND HIS FRIENDS

Children going on a picnic are given reasons for keeping water clean, putting out camp fire, cleaning up garbage, and not harming trees. 36710.1

SONNY SQUIRREL AND THE PINE TREE

How pine trees used to be cut down without regard for the future; in contrast to this, good forest management is demonstrated. 36710.11

SUSAN AND THE FOREST FIRE

How forest fires are put out. What forest fires do to animals' homes. Other results of forest fires. How we can help in preventing forest fires. 36710.12

HEALTH AND SAFETY 3700.11 Doug George Assoc.

Illustrates safe drinking water, safe ways to combat harmful bacteria, and safe methods of keeping foods.

INTRODUCING AIR 37829 Bailey

Shows that fast moving air is called wind. Sometimes air is warm and cold. Air is in and around everything.

WATER AND SOIL 37365.14 Eye-Gate

The main topic of this filmstrip is that water is everywhere. The amount of water in the world is compared to the land content. The many uses of water are shown: drinking, transportation, irrigation and water power.

WHAT MAKES THINGS DRY FASTER Jam Handy

Jane wishes she could make her painting dry faster. By means of simple experiments she learns that warm air and moving air makes things dry faster.

WIND AND WAVES 38600.15 Society for Visual Education

Emphasizes the effects of wind and water on soil and rock.

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Bibliography

The publications for children listed in this bibliography have been selected to:

provide good reading in science for children
convey the meaning and spirit of elementary science
provide science content related to the course of study
provide enriched material for children with special science interests
suggest valuable classroom procedures, experiments and projects.

Most of the publications are on the current lists of the Board of Education of the City of New York: *Library Books for Elementary and Junior High Schools; List of Textbooks for Day and Evening Elementary Schools and Junior High Schools.*

For approaches to the use of books, see *Science and The Reading Program* on pages 12-13.

Following the listing of children's books is a bibliography of professional books on the teaching of science in the elementary school.

BOOKS FOR CHILDREN

Magnetism and Electricity

BRANLEY, FRANKLYN, and VAUGHAN, ELEANOR. *Mickey's Magnet.* New York: Thomas Y. Crowell Co., 1956. unpaged.
Story of a boy's introduction to a magnet. Words are simple; pictures are amusing.

PINE, TILLIE, and LEVINE, JOSEPH. *Magnets & How to Use Them.* New York: Whittlesey House, 1963. 64 p.
Simple experiments introduce children to principles of magnetism.

VALENS, E. G. *Magnet.* Cleveland and New York: The World Publishing Co., 1964. unpaged.
Leads reader to explore, step-by-step, the basic principles of attraction and repulsion, magnetic poles, magnetic fields of earth and space.

Earth in Space

BAER, HOWARD. *Now This, Now That.* New York: Holiday House, 1957. unpaged.
Seeing things from different points of view; helps children develop concepts of space, direction, distance.

BROWN, MARGARET WISE. *A Child's Good Night Book.* New York: Wm. R. Scott, Inc., 1950. unpaged.
About birds and animals, automobiles and sailboats and finally children as they settle down for the night in the quiet darkness.

BROWN, MYRA BERRY. *First Night Away From Home*. New York: Watts, F., 1960. 64 p.
For the first time, on his own, Stevie travels the block to his friend's house and wonders why he can't fall asleep at night.

BULLA, CLYDE R. *What Makes A Shadow?* New York: Thomas Y. Crowell, 1962. unpaged.
The reader is encouraged to explore shadows and to discover what causes them.

DE REGNIERS, BEATRICE S. *The Shadow Book*. New York: Harcourt, 1960. unpaged.
A small boy observes his own shadow and others from sun-up to sun-down. How to make shadows on a rainy day. Unusual photographs.

GOUDEY, ALICE E. *The Day We Saw the Sun Come Up*. New York: Scribner, 1961. unpaged.
The story of a boy and a girl and a summer day; sunrise; shadows that change; how the earth changes all day long until the sun disappears. A child's natural questions about his world are answered simply.

HAMBURGER, JOHN. *The Day the Sun Disappeared*. New York: Norton, 1964. unpaged.
The reactions of wild animals to an eclipse of the sun. Illustrations should please all children interested in wild animals.

LEWIS, CLAUDIA. *When I Go to the Moon*. New York: Macmillan, 1961, unpaged.
The wonder and mystery of earth viewed by a space-child on the moon.

ORLEANS, ILO. *I Watch the World Go By*. New York: Walck, 1961, 40 p.
Simple, spontaneous rhymes that touch the intimate experiences of everyday life; wind, rain.

SCHLEIN, MIRIAM. *The Sun Looks Down*. New York: Abelard-Shuman, 1954. unpaged.
What the sun "sees" as it looks down on a fisherman, a field, a shepherd, a little old couple in their store and robins in their nest.

SCHNEIDER, NINA. *While Susie Sleeps*. New York: Wm. R. Scott, Inc., 1948. unpaged.
Picture book of what goes on at home, in a garden, field and downtown while the little girl sleeps. Reassurance for fear of the dark.

SCHWARTZ, JULIUS. *The Earth Is Your Spaceship*. New York: Whittlesey House, 1963, 31 p.
The idea that the earth itself is a spaceship helps to clarify the way in which we travel through space. Explains night and day, the year, provision for life on "Spaceship Earth".

SHAPP, CHARLES and MARTHA. *Let's Find Out About the Moon*. New York: Franklin Watts, Inc. 1965. 55 p.
A space-travel approach is used to teach children many concepts about the moon.

———. *Let's Find Out About the Sun*. Franklin Watts, Inc. 1965, 47 p.
The earth moving around the sun; distance and size of the sun; its importance to life on earth.

Living Things

ADELSON, LEONE. *Please Pass the Grass*. New York: David McKay Company, 1960. unpaged.
Exploration of grass, told in rhyme. Encourages observation of small things.

ADRIAN, MARY. *Garden Spider.* New York: Holiday House, 1951. 38 p.
Life cycle of the common garden spider, told realistically and accurately.

ALIKI. *My Five Senses.* New York: Thomas Y. Crowell Co., 1962. unpaged.
How the child uses his senses to discover the world around him. Shows that finding out can be fun.

ALIKI. *My Hands.* New York: Thomas Y. Crowell Co., 1962. unpaged.
Shows children how useful and important their hands are.

BANCROFT, HENRIETTA and VAN GELDER, RICHARD. *Animals in Winter.* New York: Thomas Y. Crowell Co., 1963. unpaged.
Tells what bats, woodchucks, deer, rabbits, wolves, and other animals do in winter.

BETHERS, RAY. *How Does It Grow?* New York: St. Martin's Press, Inc., 1963. 47 p.
Tells the story of many tropical fruits, nuts and spices which we know from daily experience but seldom see growing.

BLOUGH, GLENN O. *The Tree on the Road to Turntown.* New York: Whittlesey House, 1953. 48 p.
The story of an oak tree. The changing seasons, the balance of nature and the ways of animals.

————. *Bird Watchers and Bird Feeders.* New York: Whittlesey House, 1963. 48 p.
How and where to build a bird feeder; bird "menus"; identifying characteristics of birds.

————. *Who Lives in This House?* New York: Whittlesey House, 1957. 48 p.
A deserted house is tenanted by a number of busy animal families. Features robin nest construction, life inside a honey bee community, a mud dauber wasp's nest and others.

COLLIER, ETHEL. *Who Goes There in My Garden?* New York: Wm. R. Scott, 1963. unpaged.
Illustrated story of a boy who plants seeds in his garden. While watching his plants, he becomes acquainted with other forms of life in his garden.

CONKLIN, GLADYS. *We Like Bugs.* New York: Holiday House, 1962. unpaged.
Introduces the child to the insect world.

EGGLESTON, J. S. *About Things That Grow.* Chicago: Melmont.

EVANS, KATHERINE. *The Man, The Boy and the Donkey.* New York: A. Whitman & Co., 1958.
An Aesop's fable with verbal flourishes and happy pictures.

GANS, ROMA. *Birds Eat and Eat and Eat.* New York: Thomas Y. Crowell Co., 1963. unpaged.
Describes what and how much birds eat. Tells children how to set up simple feeding stations.

————. *It's Nesting Time.* New York: Thomas Y. Crowell Co., 1964. unpaged.
Describes where and how birds make their nests.

GREEN, MARY MCBURNEY. *Everybody Eats.* New York: Wm. R. Scott, 1950. unpaged.
Introduction to some common animals and the foods they eat. Told in rhythmic prose.

HAWES, JUDY. *Fireflies in the Night.* New York: Thomas Y. Crowell Co., 1963. unpaged.
Story of a boy's experiences with fireflies.

HOWES, JUDY. *Bees and Beelines.* New York: Thomas Y. Crowell Co., 1964. unpaged.
Bees are "trained" when they leave the hive to fly in a straight line, to use the sun as a guide, and to learn the signals and dances used for communication.

HUNTINGTON, HARRIET E. *Let's Go Out Doors.* New York: Doubleday & Co., 1939, 88 p.
Tells about small creatures — snails, earthworms, frogs, turtles, spiders, others.

HURD, EDITH T. *Starfish.* New York: Thomas Y. Crowell Co., 1962. unpaged.
About starfish; also introduction to animal life at the seashore.

JORDAN, HELENE J. *Seeds by Wind and Water.* New York: Thomas Y. Crowell Co., 1962. unpaged.
How seeds are carried from place to place.

KRAUSS, RUTH. *The Growing Story.* New York: Harper & Brothers, 1947. unpaged.
A little boy watches plants and animals grow and discovers that he has been growing, too.

KUNHARDT, DOROTHY. *Pat the Bunny.* New York: Golden Press, 1940. unpaged.
Paul & Judy feel real materials, smell real flowers and look into a mirror to learn about the things around them.

MARTEN, DICK. *The Fish Book.* New York: Golden Press, 1964. unpaged.
Colorful pictures of many inhabitants of the sea, such as: flying fish, whales, sea horses and turtles.

MCMILLAN, POLLY MILLER. *Little Lambs Curls.* New York: Lothrop, Lea and Shepard Co., 1962. unpaged.
The story of wool—from the lamb to blanket.

PHLEGER, FRED. *Red Tag Comes Back.* New York: Harper & Row, 1961. 64 p.
Accurate exciting story of the life cycle of the salmon. May be too long for children to read at one sitting; but they will surely want to complete it.

PHOEBE. *Noses Are For Roses.* New York: McGraw Hill Book Co., 1960, 22 p.
In rhythmic verse, tells how the senses and various parts of the body help us enjoy and explore the environment.

PODENDORF, ILLA. *The True Book of Insects.* Chicago: Childrens Press, Inc., 1954. 47 p.
About crickets, ants, bees and June bugs, and other insects; how they grow, where they live, what they do.

ROTHSCHILD, ALICE. *Fruit Is Ripe for Timothy.* New York: William R. Scott, Inc., 1963. unpaged.
Timothy shares the fruits of the different seasons with animals that like them, too.

SAXE, JOHN GODFREY. *The Blind Men and the Elephant.* New York: Whittlesey House, 1963. unpaged.
A picture book version of the famous Indian legend.

STEWART, BERTIE ANN and BURKS, GORDON E. *Turtles.* New York: Golden Press, 1962. 32 p.
Basic facts about turtles of the world in simple text and pictures.

SEIS[illegible], MILLICENT. *Plenty of Fish.* New York: Harper and Row, 1960. 62 p.
A child makes some scientific observations—on a pair of gold fish.

——— ——. *Terry and the Caterpillar.* New York: Harper and Row, 1962. 64 p.
Tells the story of the development of the Cecropia moth.

Shakelford, Nina and Burks, Gordon E. *Bird's Nests.* New York: Golden Press, 1962. 32 p.
Nest construction, shapes, sizes, materials, locations. How a robin builds a nest.

Showers, Paul. *Follow Your Nose.* New York: Thomas Y. Crowell Co., 1963, unpaged.
Explores the sense of smell.

————. *How Many Teeth?* New York: Thomas Y. Crowell Co., 1962. unpaged.
Traces the development of the teeth from babyhood to adulthood.

————. *Look At Your Eyes.* New York: Thomas Y. Crowell Co., 1962, unpaged.
Introduces children to how our eyes work.

Simon, Norma. *Tree for Me.* Philadelphia: Lippincott Co., 1956. 32 p.
A small child's joy and wonder in the growth of an apple tree.

Sutton, Felix. *The Big Book of Wild Animals.* New York: Grosset & Dunlap, 1954. unpaged.
Large pictures of familiar zoo animals and a story about their habits.

Tresselt, A. R. *Autumn Harvest.* New York: Lothrop, Lee and Shepard, 1951. unpaged.
Describes the changes that take place in the countryside in the season between late summer and Thanksgiving.

————. *Under the Trees and Through The Grass.* New York: Lothrop Lee and Shepard, 1962. unpaged.
Describes a few forest animals. Good for reading aloud.

————. *Wake Up Farm.* New York: Lothrop, Lee and Shepard, 1955. unpaged.
Acquaints children with the habits of farm animals.

Udry, Janice May. *A Tree Is Nice.* New York: Harper and Row, 1956. unpaged. unpaged.
Tells why trees are nice to have around. Pictures convey the coolness, strength and fun of trees.

Voight, Virginia F. *Picta, The Painted Turtle.* New York: G. P. Putnam's Sons, 1963. 63 p.
A young painted turtle experiences a series of adventures with many neighbors in a little pond.

Walters, Marguerite. *See How It Grows.* New York: Grosset and Dunlap, 1954. unpaged.
Story about how many things around us begin and grow. Plants and animals are included.

Watson, J. W. *Wonders of Nature.* New York: Golden Press, 1962. unpaged.
Sensitive pictures about the delightful text depict the child's wonder world.

Webber, I. E. *Travelers All. How Plants Go Places.* New York: Wm. R. Scott, Inc., 1954. unpaged.
Attractively illustrated first book of how seeds travel by land, water, air, and with the aid of animals.

————. *Up Above and Down Below.* New York: Wm. R. Scott, Inc., 1963. unpaged.
Shows the parts of a plant above and below ground, giving some idea of various kinds of stems and roots.

Wise, William. *In The Time Of the Dinosaurs.* New York: G. P. Putnam's Sons, 1963. 64 p.
Tells about the different dinosaurs who lived millions of years ago and about their eating habits.

ZIM, HERBERT. *Golden Hamsters.* New York: Wm. Morrow & Co., 1951. unpaged.
Explains how to care for hamsters in the classroom.

Sound and Light in Communication

BRANLEY, FRANKLYN M. and VAUGHAN, ELEANOR K. *Timmy and The Tin-Can Telephone.* New York: Thomas Y. Crowell, 1959. 36 p.
Making a telephone for seven year olds and younger; written in lively story fashion.

BROWN, MARGARET WISE. *The Summer Noisy Book.* New York: Harper and Row, 1951. 32 p.
Noises of the summer time are explored.

————. *The Seashore Noisy Book.* New York: Harper and Row, 1941. 42 p.
Sounds at the seashore are investigated.

————. *The Indoor Noisy Book.* New York: Harper and Row, 1942. unpaged.
A dog listens to indoor noises; children listen, too.

————. *The City Noisy Book.* New York: Harper and Row, 1942. unpaged.
The little black dog Muffin has a bandage over his eyes, but he can still hear. Children will share Muffin's interest in noises he hears.

KUSKIN, KARLA. *All Sizes of Noises.* New York: Harper and Row, 1962. unpaged.
Picture story told in rhyme. The noises a boy makes from the time an alarm clock awakens him in the morning until his father comes home at night.

MINER, O. I. S. *The True Book of Communication.* Chicago: Children's Press, 1960. 47 p. Simple factual material.

PINE, TILLIE S., LEVINE, JOSEPH. *Sounds All Around.* New York: Whittlesey, 1958. 48 p.
Concise information and simple activities designed to increase awareness of sound and the scientific principles involved.

PODENDORF, ILLA. *The True Book of Sounds We Hear.* Chicago: Childrens Press, 1961. 47 p.
Encourages sensitivity to sounds, by describing how we hear, picturing animals with different kinds of ears and "voices", and by contrasting pleasant and unpleasant sounds.

SCHWARTZ, JULIUS. *Now I Know.* New York: Whittlesey House, 1955. 32 p.
Explorations based on a child's concern about sounds, shadows, reflections and darkness.

Weather

BENDICK, JEANNE. *A Fresh Look At Night.* New York: Watts, 1963. 48 p.
Night — mysterious, cozy, exciting; for resting, dreaming, playing, working.

————. *All Around You.* New York: Whittlesey House, 1951. 48 p.
A look at the child's physical world: the earth, sun, stars, moon, shadows, clouds, wind, fog, water, soil; the plants and animals which inhabit this world.

BIRNBAUM, A. *Green Eyes.* New York: Capitol Publishing Co., 1953. unpaged.
Children can follow this delightful cat through all the seasons.

BLACK, IRMA SIMONTON. *Busy Water.* New York: Holiday House, 1958. unpaged.
The water cycle from rain to brook to river to ocean and back to clouds; told in simple text.

Blough, Glenn O. *Not Only for Ducks.* New York: Whittlesey House, 1954. 48 p.
A boy learns how rain is essential for all living things. A simple story of the weather cycle.

Branley, Franklyn M. *Rain and Hail.* New York: Thomas Y. Crowell, 1963. unpaged.
A simple explanation of what makes rain and hail.

————. *Snow is Falling.* New York: Thomas Y. Crowell, 1963. unpaged.
Snow is made to seem wondrous and yet comprehensible to children. Answers are given to "What makes snow?" "How are snowflakes formed?"

Fisher, Aileen. *I Like Weather.* New York: Thomas Y. Crowell, 1963. unpaged.
In verse form.

Foster, Doris V. *A Pocketful of Seasons.* New York: Lothrop, Lee and Shepard, 1961. unpaged.
A little boy picks up different things in different seasons. Full color pictures.

Keats, E. J. *The Snowy Day.* New York: Viking Press, 1962. 31 p.
Describes a small boy's day as he plays alone in the snow.

Parsons, Virginia. *Snow.* Garden City: Doubleday, 1962. 32 p.
Picture book of the wonders of a world blanketed in white.

Pine, Tillie and Levine, Joseph. *Water All Around.* New York: Whittlesey House, 1959. 48 p.
Explains, with simple experiments, about evaporation and condensation of water, as well as some of its other properties.

Schlein, Miriam. *Snowtime.* Racine, Wisconsin: A. Whitman, 1962. 32 p.
Snow in city and country, its pleasures and problems, are presented for reading aloud to first-graders and for trying to read for themselves.

Schwartz, Julius. *Now I Know.* New York: Whittlesey House, 1955. 32 p.
Explorations and explanations of wind, rain, thunder and lightning, shadows, darkness, and other phenomena, based on children's concerns.

Tresselt, Alvin. *Rain Drop Splash.* New York: Lothrop, Lee and Shepard, 1946. unpaged.
A picture book that tells how raindrops form a puddle that grows from pond to river and finally joins the sea.

————. *Sun Up.* New York: Lothrop, Lee and Shepard, 1949. unpaged.
The hot sun rises over a farm; a scorching day, until a storm comes along.

————. *White Snow, Bright Snow.* New York: Lothrop, Lee and Shepard, 1947. 33 p.
What snow means to the postman, the farmer, the policeman, rabbits and children. Poetically told, with striking illustrations.

Motion and Force in Transportation

Alexander, Anne. *ABC of Cars and Trucks.* Garden City: Doubleday & Co., 1954. unpaged.
Simple picture treatment of various kinds of cars and trucks alphabetically developed from Auto trailer to Zone truck. Elaborately illustrated.

Bate, Norman. *Who Built the Highway?* New York: Charles Scribner's Sons, 1963. 53 p.
Simple and exciting picture story of how a highway is built by such road-

making machines as the bulldozer, earth mover, power shovel, tamper, grader, dumptruck, roller, subgrader, road layer and finisher.

BENDICK, JEANNE. *The First Book of Airplanes.* New York: Franklin Watts, 1958. 63 p.
Simplified explanation of airplanes.

————. *The First Book of Automobiles.* New York: Franklin Watts, Inc., 1955. 65 p.
The mechanical workings of all kinds of automobiles.

BERKLEY, E. S. *Ups and Downs.* Eau Claire, Wisconsin: Hale & Co.

ELTING, MARY. *Trucks At Work.* Irvington-on-Hudson: Harvey House, Inc., 1962. 91 p.
Variety of trucks and cargoes including related aspects of trucking business. Extensively illustrated and includes glossary of terms and phrases associated with trucking.

FLACK, MARJORIE. *Boats on the River.* New York: The Viking Press, 1946. 31 p.
Magnificently illustrated book on boats in the waters around New York City. Tells of all kinds of boats and what they are doing: the ferry, riverboat, ocean liner, tugboat, motorboat, sailboat, rowboat, freighter, submarine and warship.

GOSSETT, MARGARET. *The First Book of Boats.* New York: Franklin Watts, Inc., 1953. 45 p.

JOHNSON, RYERSON. *Upstairs and Downstairs.* New York: Thomas Y. Crowell, 1962. unpaged.
Explores the various devices used for moving from one level to another: ramps, gang planks, poles, stairs, elevators.

LEWELLEN, JOHN. *The True Book of Airports & Airplanes.* Chicago: Childrens Press, 1956.
A simple, factual book.

LIEBERS, RUTH and ROTHENBERG, LILLIAN. *Stevie Finds A Way.* New York: Abingdon Press, 1958. 48 p.
A young "sidewalk superintendent" observes men build an apartment house project in his neighborhood. Stevie sees all kinds of machinery being used.

MILGROM, HARRY. *Adventures With a String.* New York: E. P. Dutton, 1965, 32 p.
Observation, reasoning and imaginative thinking are stressed through a variety of simple experiments with a piece of string.

————. *Adventures With a Ball.* New York: E. P. Dutton, 1965, 32 p.
Observation, reasoning and imaginative thinking are stressed through a variety of simple experiments with a ball.

MITCHELL, LUCY SPRAGUE and BLACK, IRMA S. ed. *Believe and Make Believe.* New York: Dutton, 1956. 190 p.
Stories and verses by authors of the Writers' Laboratory of Bank Street college. See the "Roll-Away Ball" by Ruth Sonneborn.

MUNCH, THEODORE W. *What is a Rocket?* Chicago: Benefic Press, 1959. 48 p.
Very simple material on rockets.

NEAL, HARRY E. *The Story of the Kite.* New York: The Vanguard Press, 1954. 64 p.
How kites helped Marconi catch the first wireless signal ever sent across the Atlantic; how kites carried instruments for measuring the upper atmosphere; how kites served Franklin in his discovery of electricity; how the Wright brothers made their first flight on a kite.

PINE, TILLIE S. and LEVINE, JOSEPH. *Friction All Around.* New York: Whittlesey House, 1960. 48 p.
Very simple terms used to explain what friction is and does. Easy-to-do experiments.

————. *Gravity All Around.* New York: Whittlesey House, 1963. 48 p.
A science experience book which explains in simple language what gravity is, what weight means, what gravity does to unsupported things and how we use gravity to help us.

PODENDORF, ILLA. *The True Book of Energy.* Chicago: Childrens Press, 1963. 47 p.
Introduces youngest scientists to the importance of energy in the world around us and demonstrates the many kinds of energy we know.

SCHNEIDER, HERMAN and NINA. *Now Try This.* New York: Wm. R. Scott. 1947. 40 p.
A first book on friction, levers and rollers. Simple experiments leading to an understanding of the principles involved in moving things.

SCHWARTZ, JULIUS. *Uphill and Downhill.* New York: Whittlesey House, 1965. 32 p.
Children experience gravity as they go up and down various kinds of hills. They experiment with gravity by making model hills indoors, and by watching the movement of rolling objects on them. Simply told in rhythmic prose.

SHAPP, MARTHA and CHARLES. *Let's Find Out What's Light and What's Heavy.* New York: Franklin Watts, Inc. 1960. 48 p.
Children learn the relative quality of weight; that what may be heavy for one person may be light for another: that big things may be light and little things may be heavy.

ZAFFO, GEORGE J. and BLACK, CHARLES L. *The Big Book of Real Airplanes.* New York: Grosset and Dunlap, Inc., 1951. unpaged.
Jet planes, helicopters, airplanes and lighter-than-air craft illustrated and explained. How to fly an airplane; the details of the passenger quarters in a large airliner; aviation safety aids; and how an airport operates. (In all of the "Big Book Series" younger children enjoy the illustrations; older ones read the text.)

ZAFFO, GEORGE J. and BREWSTER, BENJAMIN. *The Big Book of Real Boats and Ships.* New York: Grosset and Dunlap, Inc., 1951. unpaged.
Large realistic illustrations and factual explanations of tugboats, submarines, "boats and ships that made history," cargo vessels, ocean liners, small and odd craft, fireboats, sailboats, aircraft carriers and Coast Guard cutters. Explanations of whistle signals, ships' bells, engine-room telegraph, international code flag signals, range lights, directions at sea and light signals.

ZAFFO, GEORGE J. *The Big Book of Real Building Wrecking Machines.* New York: Grosset and Dunlap, 1951. unpaged.
Large illustrations and explanatory text about bulldozers, steamshovels, bucket loaders, rock crushers, motor-cranes, motor graders, motor scrapers, concrete mixers, cranes with "skull-crackers." Also includes pictures of small building and wrecking tools and useful power tools.

————. *The Big Book of Real Fire Engines.* New York: Grosset and Dunlap, 1950. unpaged.
Realistic illustrations of many kinds of fire trucks; a night with a fireman on duty; the fire alarm system; fire hazards in the home.

————. *The Big Book of Real Trains.* New York: Grosset and Dunlap, 1949. unpaged.
Large illustrations and brief text on the locomotive, tender, automobile car,

refrigerator car, gondola, flatcar, hopper, cattle car, tank car, caboose. Tells the purpose of each. Detailed diagram of all parts of the locomotive, indicating the job of each. Key to whistle and lantern signals.

————. *The Big Book of Real Trucks.* New York: Grosset and Dunlap, 1950. unpaged.
Big pictures of all kinds of trucks: trailers, automobile carriers, flushing machines, street sweepers, dump trucks, concrete mixers, livestock trucks, snowplows and many others.

ZINER, FEENIE. *About Wonderful Wheels.* Chicago: Melmont Publishing Company, 1959. 24 p.
A beginner's book about wheels and how man uses them.

Earth and Its Resources

BLACK, IRMA. *Busy Water.* New York: Holiday House, 1958. unpaged.
The story of the water cycle, from rain to brook to river to ocean and back to clouds, told simply.

BRANLEY, FRANKLYN M. *Air is All Around You.* New York: Thomas Y. Crowell Co., 1962. unpaged.
This book deals with the concept, "air is everywhere," in a simple way. It includes experiments to deepen the concept.

GANS, ROMA. *Icebergs.* New York: Thomas Y. Crowell Co., 1964. unpaged.
This is a simple explanation of icebergs — what they are, how they are formed and what happens to them. Effective illustrations.

————. *The Wonder of Stones.* New York. Thomas Y. Crowell Co., 1963. unpaged.
Presents the variety and the age of rocks. Well illustrated introduction to the study of rocks.

HEAVILIN, JAY. *Rocks and Gems.* New York: Macmillan Company, 1964. unpaged.
Suitable for children from different areas since it deals with rocks in the backyard, mountains, and city and at the seashore. Helpful for identifying rocks.

PINE, TILLIE S. and LEVINE, JOSEPH. *The Indians Knew,* 1957. *The Pilgrims Knew.* 1957. *The Chinese Knew.* 1958. *The Eskimos Knew.* 1962. *The Egyptians Knew.* 1964. New York: Whittlesey House, 32 p.
In each of these five books, ancient wisdom is combined with modern practice, and illuminated by simple experiments for children to perform.

SCHWARTZ, JULIUS. *I Know a Magic House.* New York: Whittlesey House (McGraw Hill), 1956. 32 p.
This book help children to look for the science in things in the home. It makes investigation fun.

SELSAM, MILLICENT E. *Greg's Microscope.* New York: Harper & Row, 1963. 64 p.
Good introduction to the microscope in which a child examines common materials (e.g., salt, sugar, plants).

SHAPP, CHARLES and MARTHA. *Let's Find Out About Air.* New York: Franklyn Watts, Inc. 1963. 42 p.
Children learn about air by finding it in a number of things, by pushing against it, collecting it, and experiencing it in other ways.

PROFESSIONAL BOOKS ON THE TEACHING OF SCIENCE IN THE ELEMENTARY SCHOOL

BLOUGH, GLENN O. and SCHWARTZ, JULIUS. *Elementary School Science and How to Teach It.* New York: Holt Rinehart and Winston, 1964.
Combines a survey of science subject content with methods of teaching in the elementary school.

CRAIG, GERALD S. *Science for the Elementary School Teacher.* Boston: Ginn and Co., 1958.
Provides the teacher with a background in science and with methods of teaching it.

HENNESSY, DAVID E. *Elementary Teacher's Classroom Science Demonstrations and Activities.* Englewood Cliffs, New Jersey: Prentice-Hall, 1964.
Materials and procedures in elementary science.

HONE, ELIZABETH B. and others. *A Sourcebook for Elementary Science.* New York: Harcourt, Brace and Company, 1962.
Techniques and procedures for teaching science.

HUBLER, CLARK. *Working With Children in Science.* Boston: Houghton Mifflin, 1957.
General treatment of problems of teaching science in the elementary school.

LEWIS, JUNE E. and POTTER, IRENE. *The Teaching of Science in the Elementary School.* Englewood Cliffs, New Jersey: Prentice-Hall, 1961.
Teaching suggestions and subject matter.

NAVARRA, JOHN G. and ZAFFARONI, JOSEPH. *Science Today for the Elementary School Teacher.* New York: Harper and Row, 1960.
Teaching suggestions and subject matter.

TANNENBAUM, HAROLD E., STILLMAN, NATHAN, and PILTZ, ALBERT. *Science Education for Elementary School Teachers.* Boston: Allyn and Bacon, 1965.
Goals, methods, child development in relation to elementary school science.

VICTOR, EDWARD. *Science for the Elementary School.* New York: Macmillan, 1965.
Teaching methods and outlines of content.

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